Feb. 26, 1946. H. R. FREUND ET AL 2,395,659

APPARATUS FOR PRODUCING JUSTIFIED TYPE MATTER

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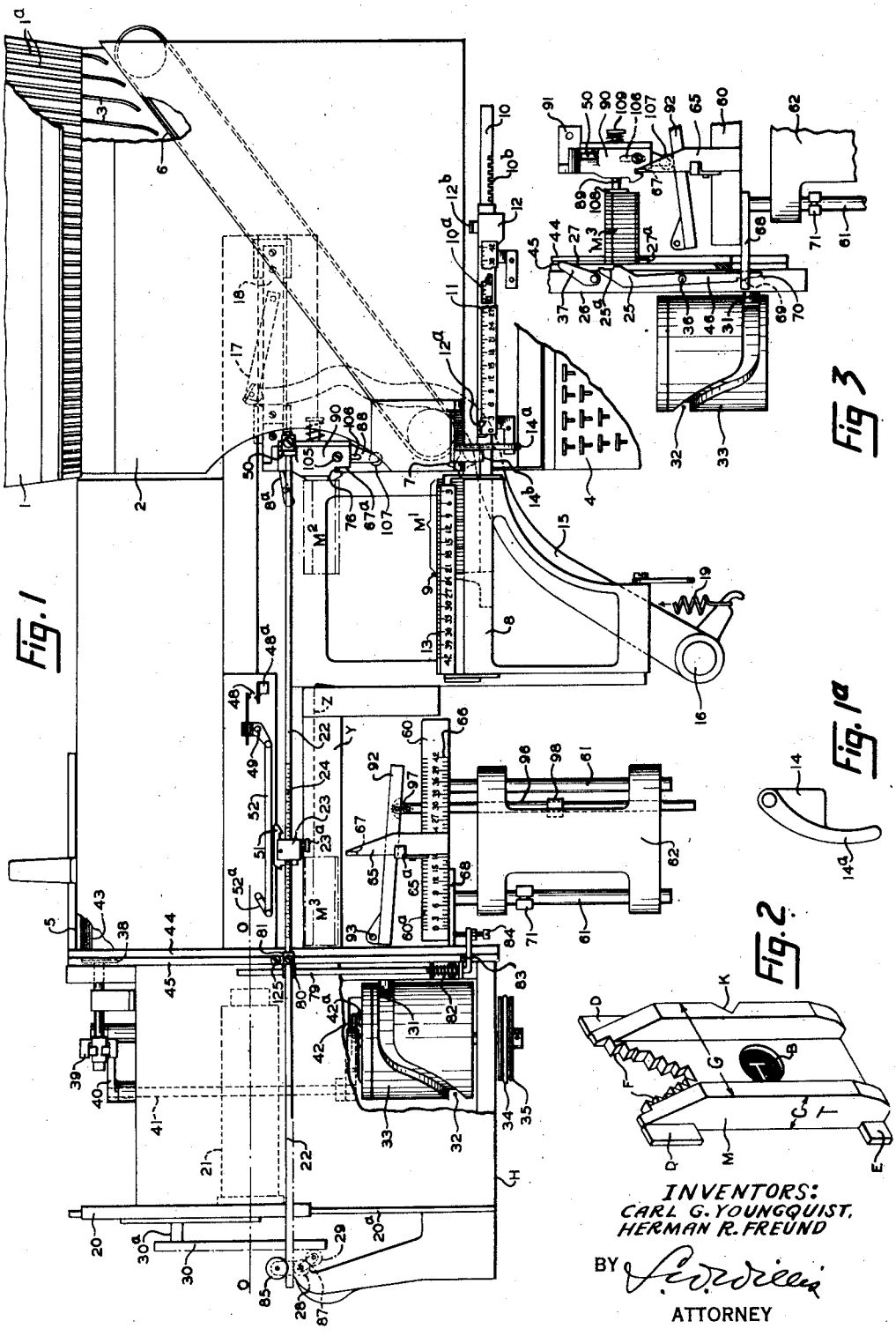


Fig. 1

Fig. 3

Fig. 1a

Fig. 2

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APPARATUS FOR PRODUCING JUSTIFIED TYPE MATTER

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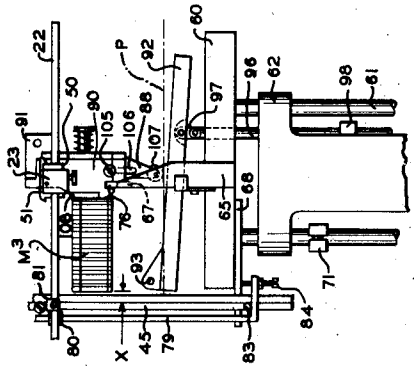


Fig. 6

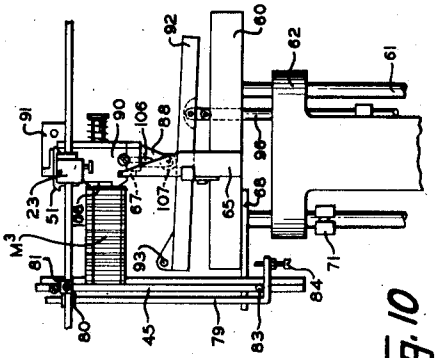


Fig. 10

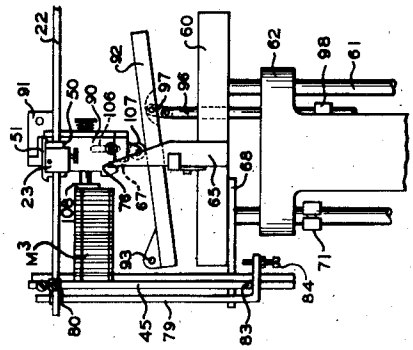


Fig. 7

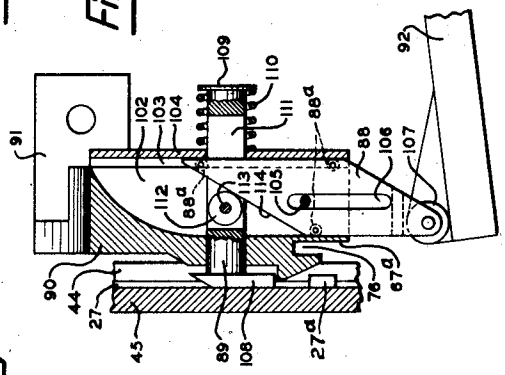


Fig. 5

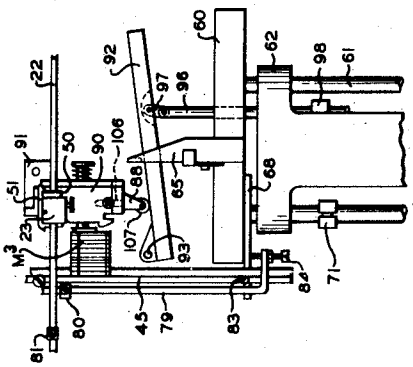


Fig. 8

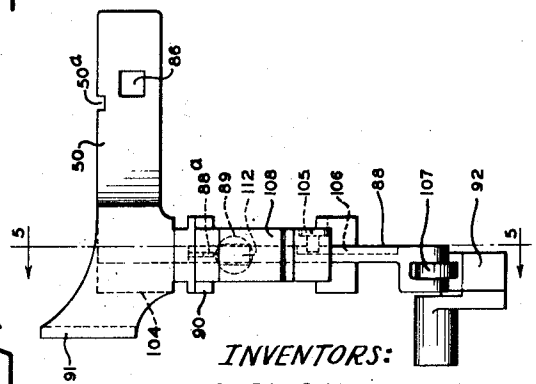


Fig. 4

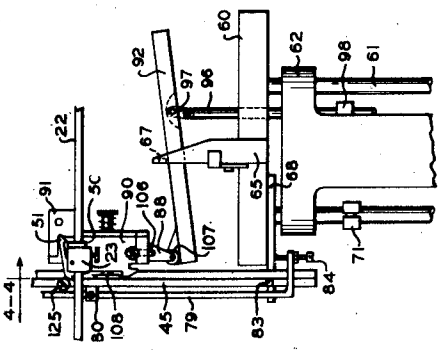


Fig. 9

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APPARATUS FOR PRODUCING JUSTIFIED TYPE MATTER

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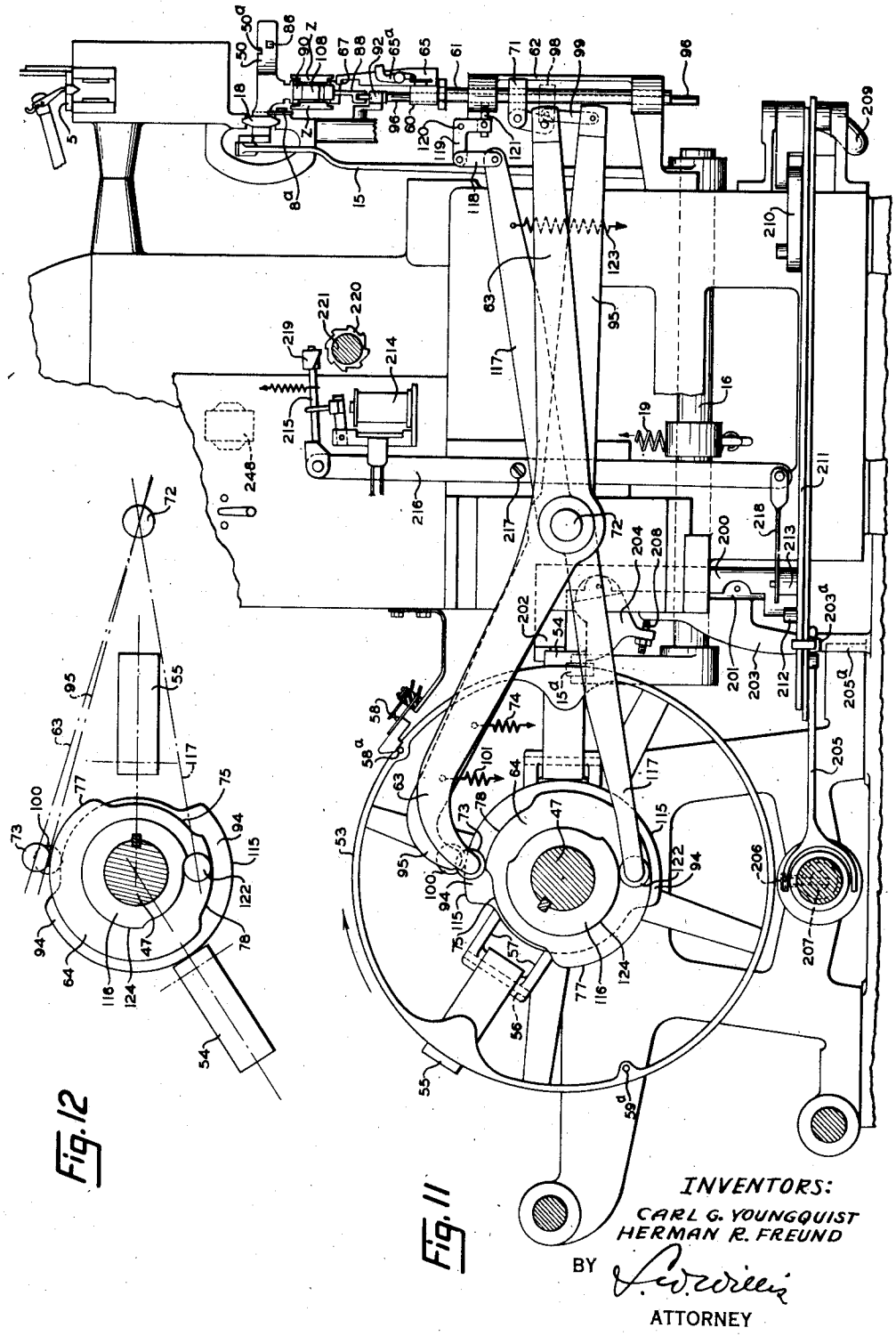


Fig. 12

Fig. 11

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Fig. 13

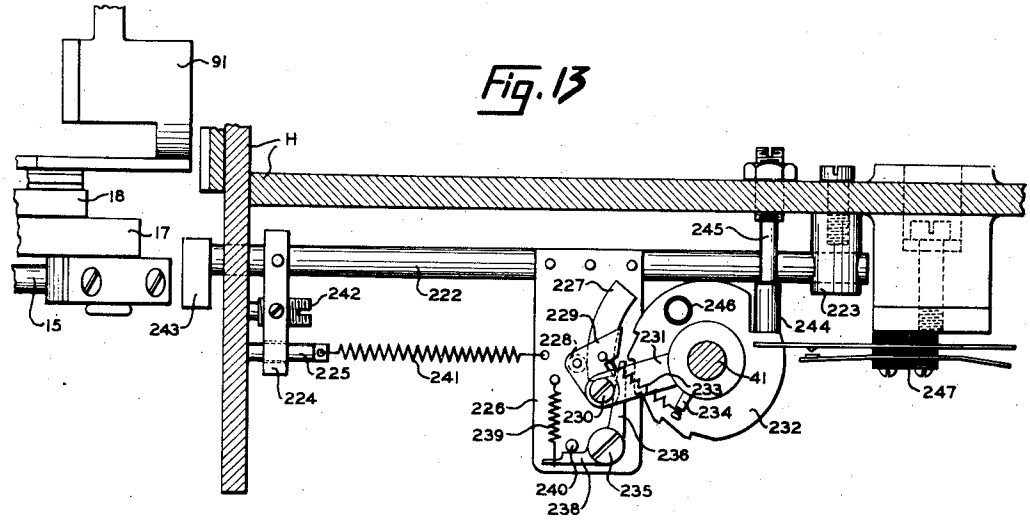
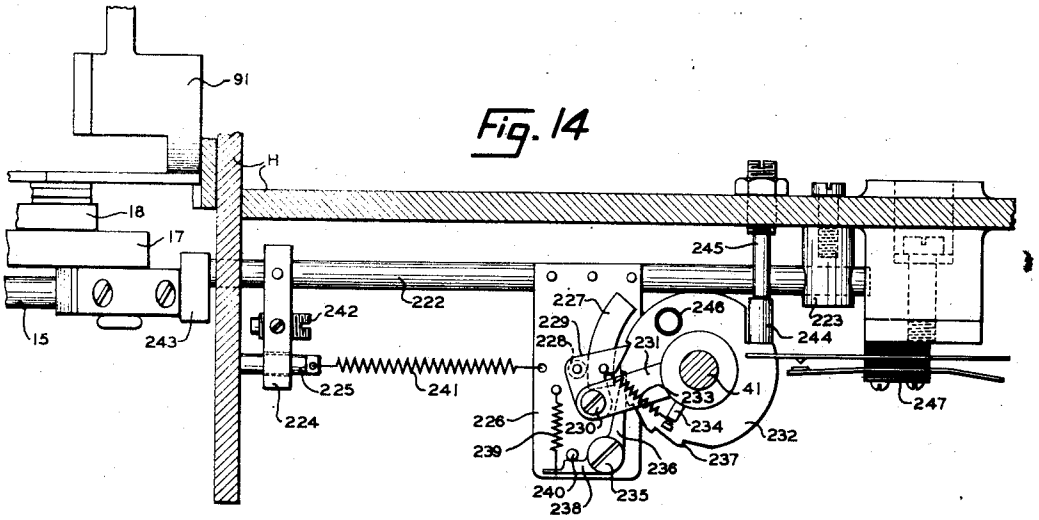


Fig. 14



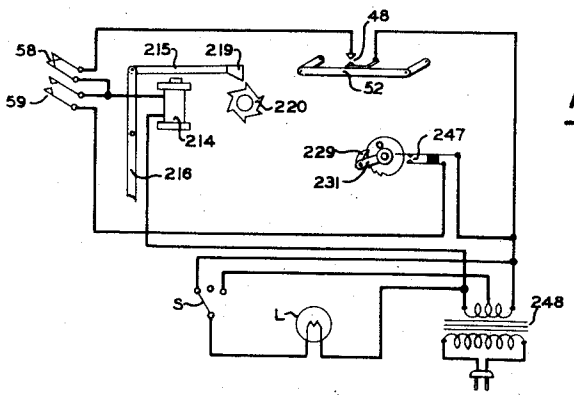


Fig. 15

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UNITED STATES PATENT OFFICE

2,395,659

APPARATUS FOR PRODUCING JUSTIFIED TYPE MATTER

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Application December 8, 1944, Serial No. 567,232
In Great Britain July 5, 1944

32 Claims. (Cl. 95—4.5)

The present invention relates to typographical machines in general and to a novel apparatus for producing in such machines justified lines of type matter as found in printing wherein the characters are spaced setwise in accordance with their variant widths, as distinguished from typewritten copy wherein the characters, regardless of their variant widths, are all allotted the same amount of setwise space. And the instant embodiment of the invention is particularly adapted to the production of such justified type matter photographically on film or paper suitable for subsequent use in offset and gravure printing processes.

For a better appreciation of the significance and accomplishments of the invention it will be helpful first to dwell briefly upon the nature of the problem of spacing and justification of printers' type and methods so far proposed for its solution. As well known to those familiar with the art of printing, this is a difficult and complex problem with which to deal because of the infinite variety of space values needed for acommodating, exactly within the limits of any chosen line length, the infinite variety of combinations of the variant and unrelated width characters that occur in matter composed in the numerous existing designs of printing type faces. Hand-set composition affords opportunity for practically unlimited refinement of both letter and word spacing in justified matter because prepared space material from tissue paper thinness upwards can be skillfully manipulated and distributed between letters and words in proper proportion to their variant widths, thus enabling the accomplishment of justification while at the same time meeting the exacting requirements of typographical perfection in spacing, that is, a properly balanced distribution of the total line-length adjustment required among both the letters and the words. Such procedure, however, is obviously far too slow and costly for the commercial production of printed matter, and it is well recognized that machine methods of justification so far devised fail to possess the degree of accuracy and flexibility in determination and execution of space values necessary to duplicate the product of the skilled hand compositor.

Up to the present, justification of lines of printers' type in the commercial practice of machine-set composition has been accomplished either directly by word-space expansion by expansible wedge spacebands as employed in machines of the Linotype class, or indirectly from a composed representation either in code (such as a punched tape as employed with machines of the Monotype class) or in some other physical form, such indirect arrangements providing for the assignment to each word space of a suitable number of space units of predetermined and fixed value for the unit system upon which the type itself is built. With these practices, however, it is feasible economically and mechanically to effect adjustment only of the word spaces and as a result, the word spaces in the different lines of a piece of composition vary from narrow to wide (all alike in any one line), thus producing the characteristic undesirable mixture of crowded and gaping appearance in the spacing of the words in the different lines.

Various other schemes have been proposed for producing justified lines through adjustment of word or letter spaces or both. Among these are such devices as apply essentially to typewritten matter and which have one or more of the following objections or limitations, viz; that all characters, regardless of their actual width, be allotted the same amount of setwise space (the characteristic of typewritten matter which distinguishes it from printed matter); that all altered spaces throughout a line be altered to the same extent; that the unjustified line be altered in length by an amount no less than the common setwise character width, and that a predetermined number of characters or spaces of known width value be contained in any given line measure.

The outstanding characteristic of printers' type is that each character has a random setwise width faithful to the design of the particular type face and occupies a setwise space commensurate with its width. Moreover, since there is no relation between the width values of different characters in a given type face or between like characters in different type faces it is clearly out of the question to attempt to estimate the number of such characters that might be fitted exactly into any given line measure. It will be obvious, therefore, that the abovementioned schemes for justification of typewritten matter are fundamentally incapable of application to or solution of the problems of justification of printers' type. In short, none of such proposed schemes is susceptible to variable adjustment of spacing between successive characters in a given line or to space adjustments in proportion to the variant widths of the characters, as required for the justification of printers' type. Moreover, the foregoing and still other proposals for effecting justification through adjustment of letter or word spacing or both have one or more of the following objections, (*a*) that they involve either manual or mechanical manipula-

tion and/or calculation, from pre-set pattern copy, of the space adjustments required for each new line as determined by a count of the letters or words and comparison thereof with a known and fixed unit character capacity for the particular line measure, (b) that each line must be reset in order to carry out the pre-calculated space adjustment, (c) that they are based upon a system of space and letter width values limited in number and size, thus restricting the range of variability of space adjustments and requiring that the characters of different type faces be distorted setwise to fit the arbitrary width values for the system.

The present invention, in its broadest aspect, is directed toward overcoming the inferior spacing of justified printed type matter as produced by commercial and thus far proposed methods or devices, and toward enabling the product of machine-set composition to meet the long sought after standards of typographical excellence in spacing as exhibited by costly hand-set composition. And it is proposed to accomplish this by entirely automatic machine actions, without limitation to any unit system of type width or space division, and without the necessity of calculation or manipulation of any kind in order to carry out the justification requirements.

To state the aims of the invention more specifically, one object is to provide for effecting justification of a line in any size or style of type face by automatic adjustment of both letter and word spaces differentially in accordance with the variant setwise widths of the type characters.

Another object is to provide for such differential adjustment of the letter and word spaces throughout a line by an infinite variety of either incremental or decremental fractional values governed only by whatever odd amount of total difference may happen to exist between the length of the line as composed and the desired justified line-length. The question of whether the length of the composed line is increased or decreased will depend, of course, upon whether the composed line is underset or overset by the operator relative to the ultimate desired line length. This feature of either expansion or contraction of a line by distribution throughout of positive or negative fractional values varying to any required extent enables more or less characters to be fitted in in effecting the completion of or an acceptable breaking up of a word falling at the end of the line. Moreover, it affords opportunity for attaining throughout the mass of lines of a given piece of composition the much desired even or uniform appearance of the spacing as a whole instead of the objectionable mixture, so common to present machine-set composition, of both gaping and narrow spaces due either to confining adjustments to equal values or to word spaces only.

A further object is to provide for carrying out line justification requirements as a progressive and automatic action during reproduction individually of the successive characters making up a line. In other words, to provide for distribution automatically of the total space necessary to be absorbed for justification purposes by individual variant amounts, and over an indefinite range of variability, properly suited to all character widths and to word intervals in respect to any style or size of type face.

Among further objects are: to perform the line justifying operation without employing the well known expansible wedge spacebands which serve primarily for word spacing only and which introduce objectionable mechanical difficulties well known to those skilled in their use; to surpass the accuracy of spaceband justification; to avoid the limitations of fixed unit justification systems; and to avoid resort to calculation or manipulation in ascertaining and transmitting the space values necessary for effecting justification.

These and other aims of the invention have been found capable of accomplishment to best advantage in connection with a machine arranged to handle composed lines of individual elements, preferably themselves carrying the respective type characters, and each element having one dimension such as a body thickness which varies in accordance with the setwise width of the character borne or represented by the particular element (one of the well known characteristics of the familiar form of matrices employed in commercial line composing and type slug casting machines), and wherein provision is made for presenting such elements separately and successively to character reproducing devices capable of responding to the aforesaid variant dimension whereby directly and correspondingly to control the relative setwise positioning of the successive characters throughout the justified line to be produced. For photographic composition a machine operating on this principle of letter-by-letter reproduction from elements capable of circulation individually would include a sensitized surface arranged to move step-by-step for each exposure under control of the individual character representing line elements of the composed line and the dimensions of the respective elements.

According to the embodiment of the invention herein disclosed and which is especially suited for application to a photo-composing machine capable of handling composed lines of individual character-bearing elements there is provided a justification space control arrangement comprising two cooperating and interdependent members which operate automatically to determine and supply the required space values for effecting justification. These members are so associated with a composed line of elements and with a sensitized surface as first, to perform a space sensing function by which automatically to detect, i. e., measure the total amount of space required to be absorbed to effect justification and then to perform a space dividing and distributing function as the elements are presented successively for photographic exposure on sensitized film or paper, preferably by displacement one-by-one from the composed line upon delivery thereof to the reproducing devices of the machine.

One of the space control members comprises a line follower unit carrying a cooperating wedge and plunger movable relative to one another and to the follower. This line follower unit serves to deliver the composed line to the element displacing mechanism and the wedge member is adapted, upon actuation by the other control member (described immediately below) to move the plunger member relative to the follower while the latter is held stationary relative to the line at a predetermined position corresponding to the line measure desired for the composition in hand. Such movement of the plunger serves to compact the composed line of elements endwise and in so doing operates not to justify the line of elements but rather to detect and measure the amount of space shortage or overage which must be accounted for in producing the justified line, i. e., to measure the total variance between the

composed and justified line-lengths. The other space control member comprises a cam guide in the form of a bar or rail pivoted at one end and adapted to swing under the influence of a lever actuated from the main cam shaft of the machine. When actuated this cam guide or rail swings and actuates the aforesaid wedge and plunger and in so doing it assumes one or another angle of inclination governed by the distance it is capable of moving the wedge and plunger in compacting the line. Such distance varies, of course, according to the variant amounts of the total space variation detected in each different delivered line.

After acting on the wedge a locking device operates to maintain the guide rail and the wedge and plunger in their relative operated positions with the wedge in contact with the rail, as through the medium of a roller carried by the wedge and adapted to ride on the rail. Following such locking action the line follower unit is released and the elements of the composed and measured line are then displaced separately and successively from the head or leading end of the line—the end remote from the follower. Upon each displacement of an element the remaining elements in the line as well as the sensitized surface are advanced by the follower unit a distance governed in part by the thickness dimension of the displaced element and in part by an incremental or decremental space value determined by a constantly changing cooperative relation between the guide rail and wedge as the roller on the latter progressively travels along the inclined rail. The specific nature and results of these and other actions and the details of construction of the mechanism involved will be better understood by reference to the ensuing description in connection with the accompanying drawings.

The embodiment of the invention as herein shown and described is merely by way of example and the form and arrangement of the various parts and their mode of operation may be varied in many different ways, and the invention may be applied to machines differing from the one herein shown and employing other forms of character-bearing elements or character representing means than herein shown so long as there exists the essentials for letter-by-letter production of justified lines of type matter. It is to be understood, therefore, that the invention is limited only insofar as expressed in the appended claims.

In the drawings:

Figure 1 is a front elevation of a machine embodying the invention, portions of the machine not necessary to a full understanding of the invention being omitted for the sake of clarity.

Figure 1ª is a perspective view of a stop lever provided for use in connection with the assembling of overset lines.

Figure 2 is a perspective view on an enlarged scale of a character bearing element suitable for use in connection with the apparatus of the invention.

Figure 3 is a fragmentary view of a portion of the machine in Fig. 1, showing details of part of the element displacing mechanism.

Figure 4 is an end elevation on an enlarged scale of the justification space control members of the invention as viewed in the direction of the line 4—4 in Fig. 9.

Figure 5 is an elevation in section taken on the line 5—5 in Fig. 4.

Figure 6 is a front elevation showing the justification space control members of the invention in inactive position relative to a delivered line of elements which is underset.

Figure 7 shows the relative positions of the line and the space control members of Fig. 6 after being operated to sense or detect the total space shortage to be absorbed by incrementing letter and word spaces in effecting justification of the underset line of Fig. 6, the line being pressed endwise leftward by the action of the control members so that its left or leading end banks against the wall of the element displacing channel.

Figure 8 shows the relative positions of the space control members after line and film advancing movement of one member relative to the other due to displacement successively of some of the elements from the leading end of the line in Fig. 7 and distribution among the photographically reproduced characters of a commensurate part of the total space shortage detected by the control members in Fig. 7.

Figure 9 shows the space control members in final line and film advancing position after displacement and photographing of all of the characters represented by the underset line of Fig. 6 and distribution among the reproduced character and word spaces of all of the space detected by the control members in Fig. 7.

Figure 10 shows the space control members of the invention in operated position relative to an overset composed line which must be shortened during its reproduction by a decrement equal to the total amount by which it exceeds the desired justified line measure.

Figure 11 is a partial side elevation from the left side of the machine showing the main cam shaft in section, the cams thereon and the levers operated thereby for effecting line delivery and line advancing actions and operation of the justification space control members, these parts being shown in their normal position.

Figure 12 shows the relation between certain of the cams and levers in Fig. 11 when the cam shaft is stopped after a partial turn while the character reproducing operation takes place.

Figure 13 is a plan view, partly in section, showing the cam shaft re-start delay mechanism which is mounted at the back of the housing located at the left end of the machine as viewed in Fig. 1, the parts of the mechanism being shown in normal position.

Figure 14 is similar to Fig. 13 but shows the mechanism therein in operated position.

Figure 15 is a circuit diagram.

The embodiment of the invention as herein disclosed is designed for application to a letter-by-letter photo-composing machine of the general organization disclosed in the pending application of E. G. Klingberg, et al., Serial No. 452,248, filed July 24, 1942, and is arranged to employ character-bearing elements of the kind used with this machine and shown and described in U. S. Letters Patent No. 2,231,925 to W. Koller and No. 2,231,899 to H. R. Freund, both granted February 18, 1941.

General organization and operation of the machine

Apart from certain modifications necessary for photographic reproduction rather than the casting of type bearing slugs, the machine herein shown is generally similar to the well known commercial form of typographical slug casting machine of the class disclosed in U. S. Patent No.

436,532 to O. Mergenthaler and the line elements employed resemble the matrices used with such machine.

Thus, there are provided the usual matrix storage, distributing and assembling mechanisms, there being shown in Fig. 1 a portion of the well known forwardly inclined matrix storage magazine 1 which is cooperative at its lower or matrix delivery end with the usual assembler front 2 between partitions 3 of which the matrices drop by gravity upon release from the magazine storage channels 1a in response to operation of the keyboard 4. At its upper end the magazine 1 cooperates with the usual matrix distributing mechanism (not shown) which in well known manner receives the matrices from a so-called second elevator 5, subsequent to the character reproducing operation, and directs them back to their proper channels in the magazine 1.

The released matrices fall flatwise onto an inclined constantly running flat belt 6 which delivers them to a common point of assembly in front of the rotating star wheel 7. The star wheel serves to flip the matrices upright so that they stand edgewise in composed order on horizontal supporting rails in the usual assembling elevator 8. Here the leading and terminal ends of the composed line are supported between the usual yielding finger 9, secured to the assembler slide 10 and the star wheel 7. To slide 10 is secured an em scale 10a by which the operator may set an elongated block 12 to the desired line measure for the matter in hand, a lip at the lower end of the usual spring-pressed finger detent 12b engaging teeth 10b in the slide bar 10 to fix the setting. And as usual, the slide 10 is under light spring tension in a rightward direction and is provided with a friction brake arrangement (not shown) which acts to hold the slide in successively advanced positions as matrices entering the assembling elevator urge the finger 9 leftward. Upon starting the composition of a line the finger 9 stands adjacent to the star wheel 7 and by observing the progress of the finger along the em scale 13 and/or the progress of the pointer 12a at the left end of block 12 relative to the fixed em scale 11, the operator is aware of the gradual increase in the length of the composed line. The left edge of the pointer 12a encounters a stop surface 14 of the usual "tight line" release lever 14a, see Figs. 1 and 1a, when the slide 10 together with its block 12 has been advanced by incoming matrices a distance corresponding exactly to the line measure for which the block 12 is set.

There is also provided the usual so-called line delivery lever 15 suitably secured to the forward end of a fore and aft rock shaft 16 supported in the machine frame. At its upper end lever 15 is loosely connected in well known manner through a swingable link 17 to the line delivery slide 18. Slide 18 usually carries at its left end a so-called delivery finger which is now replaced by the specially designed line follower unit of the present invention as shown in several of the views (designated 90) and described later on. Upon raising the elevator 8 in the customary manner in order to bring the composed line of matrices M^1 in front of the line follower (see dot-dash position M^2 of the elevated matrix line), a gravity latch 8a is tripped as usual by the elevator. The delivery slide 18 and the follower unit thereon, powered by a spring 19 acting on the delivery lever 15, then delivers the line leftward across the machine to a position designated M^3 in Fig. 1. Here the line elements hang by their upper ears D on opposed front and back supporting rails Z of the usual so-called delivery channel while a line measuring operation, as later described, takes place.

In the instant invention expansible spacebands as heretofore employed for justification purposes are not used nor is the composed line actually justified at all prior to reproduction of the characters thereof, the justification requirements being determined by the measuring operation just alluded to and then being fulfilled during the process of reproduction of the individually removed elements, all in the novel manner hereinafter explained.

For photographic purposes there is provided a film holder 20 movable on vertical guide rails 20a, a suitable light source L and suitable control switch S, see Fig. 15. Also, there is provided the obviously required exposure shutters (not shown) and a light-tight projection chamber 21 in which is situated a suitable lens, not shown. The film holder 20 is moved in a step-by-step manner for exposure individually of the characters of the line elements as the latter are displaced one-by-one from the leading end of the composed line (after its delivery to and measurement at the position M^3) and presented successively on the optical axis O—O. Such step-by-step movement is transmitted to the film holder through the medium of a toothed horizontal feed rack 22 carrying an adjustable rider 23 to which the slide 18 becomes latched upon interruption of the line delivery stroke in the manner hereinafter pointed out. The rider 23, like the block 12, is pre-set manually, by means of a clamp screw 23a, to the line measure desired for the matter in hand, an em scale 24 being provided on the rack 22 for this purpose. As the line elements are displaced upwardly one-by-one from the head of the line at position M^3 (as by opposed pawls 25 pivoted on a vertically reciprocating feed bar 26 and adapted to project into a feed channel 27, see Fig. 3) the line follower on slide 18, under the influence of spring 19, advances the remaining elements to bring each next element to displacement position. Such successive line advancing movements while the line follower is latched to rider 23 transmit corresponding movements to the rack 22 which, by means of gears 28, 29 and a vertical toothed rack 30 attached to the film holder 20, moves the latter for each exposure a distance governed (in part as will later be seen) by the edgewise thickness or body dimension of the particular displaced element—a dimension which represents the setwise width of the character borne by the element.

The line elements and displacing and feeding devices therefor

Attention is now directed to Fig. 2 of the drawings which shows the form of the line elements employed in the instant embodiment on the invention, such elements having the configuration of the well known circulating matrices used in slug casting machines of the Mergenthaler class. Specifically, the element M shown and which for convenience will be referred to as an element or a matrix is similar to that disclosed for example, in U. S. Patent No. 2,231,899 already referred to. As illustrated, the element M carries a capital letter T on a plaque such as a piece of film B so as to suit it for photographic reproduction. The plaque is secured in a recess formed in the element body and is retained in

said recess in a plane parallel to and between the broad sides of the body which define its edgewise thickness. The character is placed recumbent rather than upright relative to the height of the element because such disposition of the character permits employing a vertically movable film holder upon which gravity rather than mechanical mechanism may act to aid its step-by-step downward movements for the successive exposures. The edgewise thickness of the matrix body (the dimension C in Fig. 4) may be made equal to or in any proportion to the setwise width of the particular character on the film B.

It will be understood that the magazine 1 contains a whole font of matrices similar to the matrix M but varying in thickness according to the variant widths of the characters carried thereby. Thus, each of the channels 1a in the magazine (usually 90, although more or less may be provided) carries a plurality of like character matrices so that a proper supply of each character, lower case letters, capital letters, figures and points will always be available. The matrices are provided as usual with upper and lower sets of edgewise projecting lugs D and E respectively and with opposed combination distributing teeth F. The lugs D and E serve to support the matrices edgewise as usual in the magazine channels and for present purposes such lugs are of equal thickness edgewise on all of the matrices, thus to guide them during their travel upwardly in the grooves of the displacement or feed channel 27, Fig. 3. The notch K across the rear edge of each matrix is utilized in momentarily retaining and accurately locating the matrix in photographing position with the character on the optical axis O—O.

Circulation of the matrices from their storage magazine to the usual assembling elevator 8 has already been reviewed and it has been pointed out that the composed line is delivered leftward across the machine (out of the raised elevator 8) from the position M^2 to the position M^3 by the line follower unit of the present invention. As hereinafter explained, after moving the line to the position M^3 the delivery stroke of the follower unit is stopped. Then, after the measuring action of the justification space controls of the invention takes place the follower is released and urges the line leftward. The element displacing and photographing actions now take place, the successive elements being moved from the head of the line upwardly along the feed channel 27, see Fig. 3. It will be observed that as each element arrives at the head of the line as the latter is urged leftward off the rails Z its bottom edge rests on a lug 27^3 which holds it at the level of the rails Z in vertical alignment with the feed channel.

The displacing and feeding of the elements out of the composed and measured line is effected by the before-mentioned pair of pawls 25 which are disposed at opposite sides (front and rear) of the vertically reciprocating feed bar 26, these pawls being pivoted on a pin 36 passing fore and aft through bar 26 and being spring-pressed clockwise so that their upper ends project into the feed channel 27. The feed bar 26 is reciprocated by engagement of a roller 31 on the bar in the camway 32 of a cylindrical cam 33, the latter being rotated on a vertical axis by a belt and pulley connection 34, 35 to the usual constantly turned intermediate shaft (shaft 221 shown in Fig. 11). The rise and fall of the camway 32 is such as to impart a brief dwell to the feed bar 26 at the top and bottom of its strokes, and bar 26 is of course suitably guided for its vertical reciprocating movement.

Pawls 25 are provided with a recess 25a adapted to engage around the opposed upper lugs D of the leading line element when the feed bar 26 reaches the end of its downstroke and to elevate such element edgewise along channel 27 to a position where the character on the element aligns on the optical axis O—O. At this position the element is suitably retained (by parts not shown and having no direct bearing on the present invention or to a full understanding thereof), the character then being photographed while the feed bar makes its downstroke. The upper edge of recess 25a is tapered so that during such downstroke of the bar the spring-pressed pawls will rock backwardly and ride off the upper lugs of the matrix previously elevated and retained at photographing position and also over the lower lugs of such matrix. Upon the next upstroke of the feed bar the next leading element is displaced by pawls 25 while another pair of pawls 37 push the previously photographed element further upwardly in channel 27.

The elements thus successively displaced and photographed eventually arrive at the top of the channel 27 where they are pushed laterally by a horizontally reciprocated pusher 38, Fig. 1, onto the usual so-called second elevator bar 43 carried by the elevator head 5. In a manner well known on machines of the class disclosed in the Mergenthaler Patent No. 436,532 this elevator is operated between the matrix receiving position shown in Figs. 1 and 11 and the matrix distributing position by a cam (not shown) on the main cam shaft 47 of the machine. After accumulation on bar 43 of the group of photographed elements of the immediate line the elevator 5, 43 is raised by its cam to present these elements to the distributing mechanism (not shown) which may be of the usual construction employed on machines of the class disclosed in the Mergenthaler Patent No. 436,532 and which operates to return each element to its proper place in the storage magazine from which it was taken. The pusher 38 is reciprocated by suitable link and lever connections 39, 40, 41 to an arm 42 which latter carries a roller 42a engaging in a camway in the top of the cylinder cam 33.

The feed channel 27 is formed by grooves in vertical strips 44 fastened to a flat plate 45, these strips being spaced apart a distance equal to the body width G of the matrices and being apertured at the levels of the upper and lower lugs D and E of the matrices in a delivered line in order to allow such lugs to pass the strips and thus arrive in vertical alignment with the channel grooves. The channel grooves in strips 44 are a little deeper than the edgewise thickness of the matrix lugs in order to allow reasonable freedom of movement therethrough of the matrices.

It will be noted that the front one of the pair of pawls 25 which is clearly shown in Fig. 3 has a depending arm 46, the arrangement and purpose of which will be described later on.

Driving mechanism

Referring particularly to Fig. 11, the machine is provided with driving mechanism which includes the usual parts employed in machines of the Mergenthaler class as well as additional electrically operated controls as later described.

Among the usual driving parts are the main cam shaft 47 which is driven through the usual

form of main clutch connected to a motor (clutch and motor not shown) and which in the present instance carries a number of cams especially suited for operating the mechanisms peculiar to the present invention. There is also present the usual so-called vertical starting lever **200** adapted to rock about the vertical shaft **201** secured in the rigid base of the machine and having an arm **202** at its upper end. Pivoted on shaft **201** are the customary cooperating pawls **203** and **204** which operate in conjunction with the forked clutch lever **205** pivoted on a vertical stud **205a**, the forked end of lever **205** being connected by a pin **206** to the main horizontally slidable clutch operating shaft **207** which latter is constantly urged to clutch engaging position by a spring (not shown), all in well known manner. Further, on the cam shaft **47** is the usual so-called line delivery cam **53** carrying the usual clutch controlling pawls **54** and **55**, these pawls having limited swinging movement laterally of the cam on pins **56** secured in yoke-like bearings **57** formed in the web of the cam.

In the normal rest position of the machine, as indicated in Fig. 11, pawl **54** rests as shown on the flat top ledge of pawl **204**, a set screw **208** in the latter then acting to hold the cooperating pawl **203** rocked clockwise, as shown, whereby the downwardly extending arm **203a** of pawl **203** acts on the clutch lever **205** to hold the clutch shaft **207** in clutch disengaging position against the tension of its spring. In the intermediate rest position of the machine, indicated diagrammatically in Fig. 12, pawl **55** rests on the top ledge of pawl **204** to keep the clutch disengaged.

The clutch may be thrown into engagement manually by pulling the usual manual control handle **209** forwardly, this handle being connected by a link **210** to a fore and aft slide bar **211** and said bar having a pin **212** adapted to strike against an arm **213** of the vertical lever **200** and rock this lever anticlockwise about shaft **201** against the tension of a spring, not shown. When so rocked, arm **202** at the upper end of lever **200** kicks pawl **54** (or pawl **55** as the case may be) off the ledge of pawl **204** and the main clutch spring on shaft **207** is immediately free to throw the clutch into driving engagement.

For controlling the drive automatically there is provided a clutch control relay generally designated **214**. The armature arm **215** of this relay is pulled to closed position whenever the relay is energized in a manner shortly to appear. Armature **215** is pivoted on the upper end of a vertical lever **216** which is rockable on a fixed pivot **217** and is connected at its lower end by a link **218** to a pin in the arm **213** of the vertical lever **200**. When relay **214** is energized a dog **219** on the free end of the armature is thrown into the path of a toothed wheel **220** secured to the well known and constantly turning intermediate shaft **221** of the machine. Under such condition there is instantly imparted to the armature and lever **216** a backward kick (anticlockwise as viewed in Fig. 11) which results in throwing the dog **219** clear of the toothed wheel **220** and in rocking lever **200** anticlockwise so that pawl **54** is kicked off the ledge of pawl **204**. As already pointed out, such action allows the main clutch spring to throw the clutch into driving engagement. It will be apparent of course that if pawl **54** is the one kicked off pawl **204** to start a cycle of the cam shaft **47** (in the direction of the arrow), then when pawl **55** comes around it will strike the ledge of pawl **204** and immediately throw out the clutch whereby to stop the machine at the intermediate position indicated in Fig. 12. And when relay **214** is again energized, as it is after discharge of the last photographed element onto the elevator bar **43**, lever **216** will again be rocked and operate to kick pawl **55** off the ledge of pawl **204**. The cam shaft then turns through the remaining part of its cycle and is stopped when pawl **54** arrives on the ledge of pawl **204** and operates to disengage the driving clutch.

Automatic control of the drive is accomplished through the agency of relay **214** and certain switches now to be described. Thus, referring to Fig. 1 and to the circuit diagram of Fig. 15, there is provided a switch **48** one finger of which mounted on a fixed insulating block secured to a plate at the front of the line delivery channel. The other finger of this switch is carried on a bracket which is adapted to rock on a fixed pivot **49** and to which is loosely connected one end of a switch operating bar **52**. The opposite end of bar **52** is loosely connected to a pendant arm **52a** swingable on a fixed pivot.

Upon delivery of a line to the position M^3 the delivery stroke of slide **18** is stopped by engagement of a forwardly extended arm **50** on the line follower, see Figs. 1 and 11, against the right side of the rider **23** and by simultaneous engagement of other parts as will later be seen. In any event, as arm **50** approaches the rider **23**, it rocks a latch **51** pivoted on the rider and spring pressed in a clockwise direction. The switch operating bar **52** so closely overlies latch **51** that when the latter is thus rocked it displaces the bar upwardly with the obvious result of closing switch **48**. As soon as arm **50** rides under the hooked end of latch **51** the latter snaps down in a notch **50a** on the arm to lock the latter to the rider **23** and switch **48** immediately opens, bar **52** dropping by gravity. However, during the brief interval that switch **48** is closed the circuit to the control relay **214** is completed through this switch and a switch **58** which is the normal rest position of the machine is held closed by a pin **58a** projecting from the side of the line delivery cam **53**, see Fig. 11. Relay **214** is thus momentarily energized and the main driving clutch is tripped as already explained whereby to start the machine for the first part of its cycle which ends, after about 150 degrees rotation of cam shaft **47**, by the clutch disengaging action of pawl **55**. Switch **58** opens, of course, as soon as the cam shaft starts turning.

It is during this portion of the machine cycle that the justification space controls of the invention are operated by their controlling cams as hereinafter explained to measure the difference between the length of the composed line and the desired length of the justified line to be produced. And subsequent to this and while the cam shaft remains at rest in the intermediate position illustrated in Fig. 12, the line elements are successively and individually displaced, photographed and discharged onto the elevator bar **43**. Then after the last photographed element is discharged the timing mechanism shown in Figs. 13, 14 and 15 operates to complete the circuit through the control relay **214** whereby to effect engagement of the main clutch to complete the machine cycle—about 210 degrees further rotation of the cam shaft **47** back to its starting position.

The circuit for starting of the second part of the cam shaft cycle is fully completed through the timing mechanism just referred to and a switch **59** which latter, at the intermediate stop-

ping position of the machine, is held closed by a pin 59a in the side of the delivery cam 53. Switch 58 is mounted immediately behind switch 58 as viewed in Fig. 11.

The timing mechanism mentioned has the purpose of delaying the start of the second part of the cycle while the last element displaced out of the composed line of elements is moved upwardly to the top of the feed channel 27 by the continued reciprocating and elevating action of the feed bar 26 and is finally discharged onto the elevator bar 43 by the reciprocating pusher 38. This timing mechanism, as seen in Figs. 13 and 14, comprises a rod 222 slidable endwise in a suitable fixed guide post 223 at the rear of the housing H for the photographing devices (the box-like housing at the left end of Fig. 1) and in a bore in the right side of this housing as viewed in Fig. 1. Pinned to rod 222 is a supporting strap 224 which is bored to fit freely over a fixed stud 225 whereby to keep the rod from turning in its bearings. Also pinned to rod 222 is a flat plate 226 provided with an upstanding arc-shaped boss 227 against the outer edge of which rests a roller 228. Roller 228 is carried on a pin projecting downwardly from a pawl 229 pivoted at 230 on the outer end of an arm 231, the latter projecting from the hub of an escapement wheel 232 which is constantly oscillated by the action of the camway in the top of the cylinder cam 33 on roller 42a at the free end of arm 42 pinned to the lower end of shaft 41. Wheel 232 turns about shaft 41 against a winding spring (not shown) encircling said shaft and fastened at one end in a hub of the wheel and at the other end in a fixed web at the back of housing H. It will be recalled that the pusher 38 is reciprocated through lever and link connections 39, 40 to the shaft 41. Roller 228 is held against the boss 227 by a spring 233 secured to a pin in pawl 229 and to the pin 234 in the hub of wheel 232. Also on the upper side of plate 226 there is pivotally mounted on a stud 235 a ratchet lever as shown, the arm 236 thereof, and likewise the free end of pawl 229, being adapted to project into the path of teeth 237 on wheel 232 when rod 222 is shifted to the right (as viewed from the back of the machine in Figs. 13 and 14). To the other arm 238 of the ratchet lever is fastened a spring 239 hooked at its other end to a pin in plate 226 as indicated and urging the lever clockwise against a stop pin 240 in said plate.

When rod 222 is shifted to the left, as shown in Fig. 13, where it is normally held by a spring 241 hooked to plate 226 and to stud 225, the ratchet arm 236 is held out of the path of teeth 237 and boss 227 acting on roller 228 serves to hold pawl 229 rocked back out of the path of said teeth against the tension of spring 233. An adjustable stop screw 242 in the strap support 224 limits the leftward shift of rod 222 by spring 241.

Rod 222 and plate 226 secured thereto are shifted to the right (as viewed in Figs. 13 and 14) against the tension of spring 241 upon engagement of the upper end of the delivery lever 15 with a shoe 243 secured to the adjacent end of the rod which is exposed beyond the wall of the housing H and thus lies in the path of movement of lever 15 as it advances the line follower after elevation in the feed channel 27 of the last line element or matrix. The arrangement is such that the last forty-thousandths of an inch advance of the follower (the thickness of the matrix lugs and of the thinnest matrix in a font) shifts rod 222 a corresponding amount, thus moving ratchet arm 236 into engagement with the second tooth on wheel 232 and allowing pawl 229 to swing clockwise on its pivot, under the pull of spring 233, into engaging relation with the first tooth on said wheel as shown in Fig. 14.

Remembering that arm 231 which carries pawl 229 is constantly oscillating, it will now be evident that pawl 229 engages a succeeding tooth on wheel 232 at each oscillation of shaft 41 and thus advances the wheel step-by-step clockwise. Ratchet arm 236 engages the following tooth after each advancing step to hold the wheel from turning backward under the pull of the aforementioned winding spring encircling shaft 41. Normally, when not advanced, a circumferentially disposed stud 244 in wheel 232 banks against a stop 245 adjustably mounted in the rear well of housing H, and in this position the wheel is under the minimum tension of the aforesaid winding spring, the tension becoming greater as the wheel is circumferentially advanced. Suitably secured to the upper side of wheel 232 is a stud 246 of insulating material such as hard rubber, and on a boss projecting from the back wall of housing H is a block having mounted thereon the insulated contact arms of a switch generally designated 247, one of said switch arms projecting into the path of the stud 246.

The contacts of switch 247 are normally open and are connected through switch 59 to the coil of relay 214 and to the secondary winding of a line transformer 248. Thus, with switch 59 held closed, as it is by pin 59a when the cam shaft is stopped in the intermediate position by pawl 55, relay 214 will be energized only when switch 247 is closed. This occurs when shaft 41 has made enough oscillations after the shifting of rod 222 by the delivery lever 15 to advance wheel 232 clockwise to the extent that stud 246 thereon engages with and presses the contacts of switch 247 closed. It is during this period of extra oscillations after the last matrix is elevated to the optical axis that said matrix is moved upwardly to and then discharged from the top of the feed channel 27 by the pusher 38 as shaft 41 oscillates.

It will now be evident that the timing mechanism just described delays the re-starting of the cam shaft 47 to allow time for discharge onto the second elevator 43 of the last line element, and that the main clutch is thrown in to start the shaft turning through the second part of its cycle as soon as the timing switch 247 is closed as described. The cam shaft then turns until pawl 54 comes around again into engagement with the ledge of pawl 204 and operates to throw out the clutch. Relay 214 is of course de-energized as soon as the cam shaft starts turning, pin 59a at that moment leaving the contacts of switch 59 free to spring open to break the relay circuit.

Shortly after the cam shaft starts turning the usual roller 15a on an arm at the inner end of the delivery lever shaft 16 is picked up by the gradual outwardly flaring surface of cam 53 (a surface not shown but of well known construction and flaring from the rear side of the periphery of cam 53 as viewed in Fig. 11). Cam 53 thus starts the delivery lever and slide 18 with its line follower on its return stroke, eventually back to the position indicated by dotted lines in Fig. 1. As the upper end of the delivery lever 15 now retreats from shoe 243, spring 241 urges rod 222 and plate 226 thereon to the left as seen in Figs. 13 and 14 until stopped by screw 242.

Such sifting of rod 222 results in rocking pawl 229 backward out of engagement with the teeth in wheel 232 and at the same time withdrawing the ratchet arm 236 backward out of engagement with said teeth. Thereupon, the torsion spring (not shown) encircling shaft 41 and against which wheel 232 was turned relative to said shaft forcibly rotates the released wheel 232 counterclockwise until stud 244 thereon banks against stop screw 245. Thus the various parts of the timing or delay mechanism are returned to their normal positions as shown in Fig. 13.

Line delivery stop and element displacement delaying action

As hereinbefore stated, the leftward or delivery stroke of the line delivery slide 18 and the line follower thereon is interrupted after delivery of the composed line to the position M^3. Thus, beneath the horizontal channel, generally designated Y in Fig. 1, in which the delivered line is supported in known manner on suitable front and back rails Z there is provided a crossbar 60 rigidly secured to vertical rods 61 slidable in a fixed bracket 62. Bar 60 is elevated and lowered at the proper times by a lever 63 controlled from a cam 64 on the main cam shaft 47. Crossbar 60 carries a block 65 which, by means of a finger latch 65^a on the block and teeth 60^a on the bar may be pre-set by the operator in correspondence with the line measure settings of the rider 23 and the assembler slide block 12, an em scale 66 being provided on the crossbar for this purpose. Block 65 is provided at its upper end with an inwardly projecting lug 67 and at the normal elevation of crossbar 60 this lug lies in the path of leftward movement of a surface 67^a of the line follower block 90, see Figs. 6 and 11. Surface 67^a engages against lug 67 at the same time that latch 51 on rider 23 engages recess 50^a in arm 50 of the follower. It will be apparent that these engagements occur simultaneously from the fact that rider 23 and block 65 are pre-set to corresponding line measure positions as just stated above, the em scales 24 and 66 being relatively positioned to correspond with the vertically unaligned surfaces of the rider 23 and lug 67 against which respectively the arm 50 and surface 67^a of the line follower engage.

Referring for a moment to Fig. 6, it will be evident that should a line composed somewhat longer than the one here shown be delivered to the position M^3, the leading element might stand so close to the left vertical wall 45 of the feed channel 27 as to be engaged and displaced upwardly by the lower pawls 25 prematurely, that is, before completion of the line measuring action of the justification controls of the present invention. The possibility of a leading element entering the feed channel when the line delivery stroke is stopped by lug 67 will be realized from the fact that lines are usually composed in the assembling elevator 8 as nearly as possible within the ultimate desired line measure defined by the pre-settings of blocks 12 and 65 and the rider 23 (although lines may also be over-set as will later be seen) and from the further fact that momentum imparted to the line moving across the machine on rails Z under the action of lever 15 and its spring 19 tends toward overthrow of the leading element or elements when the delivery stroke is interrupted.

In order to prevent premature displacement of the leading line element the beforementioned depending arm 46 on the front one of the lower pair of pawls 25 cooperates with a rectangular plate 68 suitably secured to the underside of crossbar 60 at the left end of the latter. As best seen in Fig. 3, the plate 68 is provided with an aperture having an inclined operating edge 69 adapted to cooperate with a correspondingly inclined surface 70 at the lower end of the depending pawl arm 46. The arrangement is such that until the cam plate 68 is lowered out of reach of arm 46 (or surface 70 thereof) the lower pawls 25 will be rocked backwardly against the clockwise urge of their spring each time the feed bar 26 approaches the end of its downstroke, and the upper or matrix lifting end of the pawls will be correspondingly retracted out of range of the upper lugs D of a leading element. This relative condition is clearly shown in Fig. 3 wherein the crossbar 60 carrying the cam plate 68 is shown in the somewhat elevated position to which it is moved by its operating lever 63 just as the cam shaft 47 starts the first part of its cycle, thus to temporarily lock the lug 67 with the follower 90 in the manner about to be described. Such locking of lug 67 and such backward rocking of pawls 25 maintains until the crossbar 60 with its plate 68 is lowered which occurs toward the end of the first cycle of rotation of the cam shaft and after the justification controls of the invention have been operated.

For elevating and lowering the crossbar 60 the forward end of lever 68 is connected to the bar by means of a loose link and a clamp 71 which is secured to one of the rods 61, see Fig. 11. Lever 63 is pivoted on a shaft 72 fixed in the machine frame and carries at its inner end a roller 73 adapted to follow the contour of cam 64, a spring 74 urging the lever counterclockwise to maintain contact of the roller with the cam. The point on cam 64 at which roller 73 rests when the machine is idle is designated 78 in Fig. 11 and in this position of the parts bar 60 with its block 65 and cam plate 68 stands in the intermediate or normal elevated position indicated in Figs. 1 and 6. Here the lug 67 lies in the path of leftward movement of the surface 67^a of the line follower 90 (to interrupt the line delivery stroke) and cam plate 68 is disposed for effecting the abovementioned rocking backwardly of the lower set of lifting pawls 25 in order to delay the element displacing action.

This condition prevails until arm 50 on the follower 90 strikes rider 23 and is engaged by latch 51 and surface 67^a of the follower simultaneously encounters lug 67. At this time, as already stated, switch 48 is closed through tilting of latch 51 and inaugurates rotation of the main cam shaft 47. Roller 73 then follows the depression 75 in cam 64 whereupon spring 74 acts to rock lever 63 counterclockwise. As a result, crossbar 60 is elevated in order to enter lug 67 into the notch 76 in the line follower to effect the aforesaid temporary locking engagement of the follower and block 65 as indicated in Figs. 3, 7 and 10. In this elevated position of bar 60 the cam plate 68, as best seen in Fig. 3 is still disposed for effecting retraction of the lower pawls 25 in order still to delay the element displacing action.

With the lug 67 thus engaged in notch 76, the block 65 and the line follower 90 together form a rigid wall at the right end of the delivered line of elements. This condition wherein the delivered line is more or less confined in the space between wall 45 and the follower prevails while the justification controls of the invention operate, as will later be seen, to compact the line against wall 45.

Thereafter, a hump leading to a concentric raised surface 77 of cam 64 acts to rock lever 63 clockwise. The crossbar 60 is then lowered to break the locking engagement of lug 67 in notch 76 to release the line follower and to move the lug down clear of the body of the follower preparatory to the start of the element displacing action. This releasing action occurs shortly before shaft 47 has completed its first cycle of rotation and come to rest, but the cam depression 75 is of sufficient duration meanwhile to permit operation of the justification controls. And when the bar 60 is thus lowered (to the position indicated in Figs. 8 and 9) the cam plate 68 is also lowered out of range of arm 46 so that pawls 25 are no longer cammed backward as bar 26 reciprocates. Instead, pawls 25 are free to engage and displace the leading line element upwardly in the feed channel 27 and the released line follower, under the influence of the lever 15 and spring 19, is free to advance the line bodily leftward after each displacement of an element. While the cam shaft now remains at rest the elements of the line are individually and successively displaced, photographed and discharged from the top of the feed channel. Then, during the subsequent rotation of the cam shaft the surface 77 of cam 64 retains the crossbar 60 at lowered position until somewhat before completion of the second part of the cycle, about 210 degrees, roller 73 then riding down to the intermediate surface 78 which allows lever 63 to rock counterclockwise and raise and retain bar 60 at the intermediate or line receiving level of Figs. 1 and 6.

Film release and advancing actions

As just stated above, when crossbar 60 is moved to its lowest position pawls 25 are rendered active to effect individual and successive displacement of the line elements and lug 67 is withdrawn downwardly to release the line follower for advancing the line leftward after each displacement of an element. Such lowering of cross bar 60 also operates to actuate a vertically slidable rod 79 whereby to release the film feed rack 22 for step-by-step advance of the film (together with the follower 90) from a common initial starting point as the matrices or line elements are successively displaced. As seen in Fig. 1, rod 79 carries a stop 80 near its upper end which is adapted normally to lie in the path of leftward movement of a similar stop 81 secured to rack 22. A spring 82 encircling rod 79 between a fixed collar on the latter and a guide bracket on plate 45 serves to urge the bent-over lower end of the rod upwardly against a fixed pin 83 in the plate. An adjustable screw 84 in the bent-over end of the rod lies in the path of vertical movement of crossbar 60 and when the rod banks against pin 83, screw 84 is set to bank against the underside of the cam plate 68 on the crossbar in the normal position of the latter as shown in Figs. 1 and 6. The screw may, of course, be arranged to bank directly against the crossbar 60. In any event, in this relative condition of the parts stops 80 and 81 cooperate to prevent leftward movement of rack 22.

When crossbar 60 is moved to its higher elevation, as indicated in Figs. 7 and 10, rod 79 rests against pin 83 so that stop 80 remains in the path of stop 81 on rack 22. But when the bar 60 is moved to its lowest position, Figs. 8 and 9, it depresses rod 79 away from pin 83 and withdraws stop 80 from in front of stop 81. It will now be apparent that simultaneously with the lowering of the crossbar 60 to free the line follower unit and to render the lift pawls 25 operative the film feed rack 22 is also released for step-by-step advance leftward by the follower as the latter advances after each displacement of a matrix, it being remembered that the line follower is held by latch 51 to the rider 23 which is clamped to rack 22.

The toothed underside of rack 22 is held in mesh with gear 28 by means of an overlying flanged roller 85. Gear 28 drives a gear 29 fixed to the forward end of a fore and aft shaft having a similar gear fixed thereon and meshing with the vertical toothed rack 30 secured to the film holder as by a bracket 30^a. The right end of rack 22 is supported for free sliding movement in an aperture 86, Figs. 4 and 11, in the forward projecting arm 50 of the line follower. Also, it may be stated that gear 29 is mounted on a hanger 87 which is swingable about the axis of gear 28, the purpose of this being to permit substitution of different size gears 29 in order to vary the ratio of movement of the film holder 20 relative to rack 22 to suit different basic type sizes.

Justification space controls

As previously pointed out, after each displacement of a leading matrix or line element the remaining matrices are advanced bodily by the line follower, under the influence of spring 19, to bring the next succeeding element into displacement position against wall 45 of the feed channel and to simultaneously advance the film. In accordance with the present invention the amount of each such advance is governed in part by the character-width representing dimension of the displaced matrix and in part by an incremental or decremental space value determined by the justification space control members now to be described.

In order to control the advance of the film so that the line of photographic impressions of the characters produced thereon will be justified, the invention provides two cooperating and interdependent members which are adapted automatically to determine and supply, progressively during the individual photographing operation, a space increment or decrement (whichever may be required) of proper value for ultimate justification of the finished line and at the same time proportioned to the variant widths of the successively photographed characters.

One of the justification space control members is constituted by the vertically slidable wedge 88 and associated horizontally slidable plunger 89, see Figs. 4 and 5, these elements together with the block 90 in which they are carried forming the special line follower unit of the invention to which reference has already been made and which is rigidly secured to the left end of the line delivery slide 18, as by means of an angle bracket 91. The other control member is constituted by a bar or rail 92 pivoted at one end on a pin 93 in a rigid part of the machine frame and swingable vertically about said pin under the influence of an operating cam 94, lever 95 and rod 96, see Fig. 11, rod 96 being loosely connected to rail 92 as by a free link 97.

As indicated, rod 96 is guided for vertical sliding movement in the fixed bracket 62 and as best seen in Fig. 11, this rod is operatively connected to the forward end of lever 95 by means of a clamp 98 (similar to clamp 71) and a free link 99.

Lever 95 is pivoted on shaft 72 and carries at its inner end a roller 100 which through the downward urge of a spring 101 is caused to follow the contour of its operating cam 94 on the main cam shaft 47. When the cam shaft is at rest with the machine in normal position roller 100 rests on the high portion 115 of cam 94 and holds rail 92 at its normal position in which it is disposed at an incline downwardly to the right as indicated in Figs. 1 and 6.

Reverting to the line follower unit and referring to Figs. 4 and 5, the wedge 88 is confined in a parallel sided vertical recess 102 formed centrally of and extending in a lateral direction partially through the line follower block 90. The width of this recess is made somewhat greater than the thickness of the wedge in order to allow the latter to slide up and down freely therein. The right vertical edge of wedge 88 is guided in a groove 103 of the same width as recess 102 and formed in the inner face of a cover 104 secured to block 90. A stop screw 105 in block 90 extends into a shallow slot 106 formed in the front face of the wedge as seen in Fig. 5, in order, in particular, to limit its downstroke. To assure free up and down movement of the wedge without danger of cramping or undue friction, small rollers 88a are provided in its opposite vertical edges, these rollers riding on the adjacent vertical end surfaces of the recess in which the wedge is confined within the block 90. The forked lower end of wedge 88 carries a roller 107 which aligns longitudinally and vertically with rail 92 along the top surface of which the roller is adapted to ride.

Plunger 89 is supported for free sliding movement in a horizontal bore located centrally of and extending laterally through block 90 and through cover 104. At its left end plunger 89 is provided with an enlarged rectangular head 108 having a flat inner face adapted to bank against the left vertical edge of block 90, and having a parallel outer face adapted to engage flatwise against the last matrix in a line presented in front of the line follower unit and also against the wall 45 of the feed channel 27, all in a manner shortly to appear. At its right end plunger 89 is provided with a collar 109 between which end the cover 104 is a spring 110 adapted to urge the plunger head 108 against block 90 and to cause the plunger definitely to follow the up and down movements of the wedge.

Extending centrally through a portion of the stem of plunger 89 is an elongated vertical slot 111 within which is a roller 112 carried on a fore and aft pin 113 in the plunger stem. Roller 112 is adapted to ride on the inclined edge 114 of wedge 88 as the wedge and plunger partake of relative movement in the manner hereinafter explained. As will be evident from Figs. 4 and 5, wedge 88 extends upwardly through slot 111 in plunger 89 and this is so even when the upper end of slot 106 in the wedge rests directly against the stop screw 105. The arrangement is such that when the plunger head 108 banks against block 90 and slot 106 rests on screw 105, the roller 112 will be in contact with the wedge incline 114.

The condition as just related exists when the delivery slide 18 is held in its normal position by latch 8a as indicated in Fig. 1. And the same condition maintains during leftward travel of the slide and line follower unit to deliver a line to the position M3 and until shortly after the main cam shaft has started through closing of switch 48 by latch 51. In other words, the wedge and plunger elements of the line follower unit and also the rail 92 remain inactive, with the wedge extended down against screw 105, until the follower unit is locked by latch 51 to the rider 23 and until crossbar 60 has been elevated, through starting of the main cam shaft, whereby to enter lug 67 into notch 76 and thus provide the beforementioned rigid wall at the rear end of the delivered line.

Thus, as indicated in Fig. 6, the line delivery stroke of slide 18 has been stopped by engagement of surface 67a of the block 90 against lug 67. Here it will be seen that roller 107 on wedge 88 stands above and clear of rail 92, the wedge and rail being in their normal or inactive positions. As the main cam shaft now starts to rotate (due to the closing of switch 48 as arm 50 tilts latch 51) bar 60 is at once elevated by lever 63 to engage lug 67 in notch 76 of block 90, and as best seen in Fig. 11 this is immediately followed by the dropping of roller 100 off the high surface 115 of cam 94. As a result, lever 95 is rocked counterclockwise by its spring 101 so that rail 92 is caused to swing in the same direction about its pivot mounting 93. Upon so swinging rail 92 encounters roller 107 and drives wedge 88 upwardly in recess 102. The inclined edge 114 on the wedge then tracks on roller 112 and drives plunger 89 leftward in opposition to spring 110. Simultaneously, of course, the plunger head 108 and the delivered line of matrices are forced leftward until the leading matrix is pressed against the rigid wall 45 of the feed channel 27 as indicated in Fig. 7. Meanwhile, the follower block 90 remains stationary, of course, due to the rigid condition created by the locking of lug 67 in notch 76.

It will be evident that such upward movement of the wedge and leftward drive of the plunger will be possible so long as the length of the delivered line is less than the total space between wall 45 and the face of plunger head 108 in its fully retracted position against block 90. As seen in Fig. 6, the delivered line shown is short, by the amount X indicated, of filling up the space between the matrix engaging face of the plunger head 108 and the wall 45 opposite the leading end of the line when the delivery stroke is stopped by lug 67. In Fig. 7 the shortage X as represented by the distance plunger 89 was advanced, by the swinging of rail 92 to the inclination shown, in pushing and thus compacting the composed line of elements against wall 45. It will also be evident that the ultimate inclination of rail 92 and the corresponding extent of relative movement of the wedge and plunger will vary according to variations in the length of different composed lines delivered to the position M3, and that when the high surface 115 of cam 94 passes from beneath roller 100 the latter will stand free to a greater or less extent of the lower and concentric surface of this cam except in the event of a line that is excessively short. In other words, cam 94 is formed low enough to permit such extent of upward swing of rail 92 as will allow for the maximum shortage it is practicable to deal with in the length of any composed line.

Referring to Fig. 11, there is provided on the main cam shaft another cam 116 which serves to operate a lever 117 pivoted at 72. At its forward end lever 117 is connected, through a link 118 and a two-armed lever 119 mounted on a fixed pivot 120, to a locking bolt 121 which latter is slidable horizontally in a force and aft direction in a suitable bore in a portion of bracket 72.

The front end of bolt 121 is disposed for movement into and out of engagement with the vertical rod 96 by lever 117 which at its inner end carries a roller 122 adapted to follow the contour of cam 116 under the urge of a spring 123 acting on the forward arm of the lever. When moved into engagement with rod 96 bolt 121 serves to lock the rail 92 in the inclined position it assumes after actuating the wedge and plunger elements. Thus, shortly after roller 100 drops off surface 115 of its cam, roller 122 leaves the high portion 124 of cam 116 and lever 117 is then rocked clockwise by its spring 123. As a result bolt 121 is driven forwardly into locking engagement with rod 96. The composed line of elements is then held in compacted condition between the outwardly driven plunger head 108 and the wall 45 as shown in Fig. 7.

To summarize; during the period of interruption of the line delivery stroke and while the cam shaft 47 is turning through the first part of its cycle (about 150 degrees) the element displacement action is delayed while the justification control members (rail 92, wedge 88 and plunger 89) act to compact the line of elements, such members being operated to whatever extent may be possible in view of the length of the line as composed by the operator and delivered to the position M3. Bolt 121 is then operated to lock these control members one with respect to the other in their relative operated positions whereupon crossbar 60 is lowered to release the line follower 90 and to withdraw stop 81 whereby to release the film feed racks and the lower pair of lifting pawls 25. The cam shaft is then stopped by pawl 55 in the manner already described (see the stopped position shown in Fig. 12) ready for the element displacing and character photographing operations.

When the justification control members are actuated they first perform with respect to the delivered line, what may be aptly termed a "space sensing or detecting" function in that they cooperate with the composed line to detect and measure the total amount of space which must be accounted for to accomplish justification, that is the total variance between the composed and justified line-lengths. And when locked in their relative operated positions they serve, in effect, to store up the measured amount of space. Thereafter, these members cooperate interdependently to divide up and distribute this total space or line-length variance progressively among the photographed characters of the individually displaced matrices in the following manner.

Justification action

Before discussing the justification actions with respect to underset, overset and exact length lines, the disposition of and relation between the justification control parts 92 and 107 before and after their operation should be fully understood. To explain, the point of intersection of the top surface of rail 92 with a line drawn normal to this surface and through the center of pivot 93 lies one-half em above the periphery of roller 107 when wedge 88 rests down on screw 105. And the axis of roller 107 is located at the same horizontal level as the pivot axis 93 of rail 92. Accordingly, since roller 107 obviously travels along the horizontal path P, see Fig. 6, during the line delivery stroke—and assuming for the moment that there is no line of elements present to interrupt the leftward movement of the line follower unit 90—the roller would contact rail 92 (at its normal or inactive inclination in Fig. 6) somewhat in advance of the pivot 93. Upon riding on the upwardly inclined rail from such point of contact (the point of intersection of path P with the top of rail 92) to the end point illustrated in Fig. 9 where the axis of the roller coincides with the pivot axis 93, the plunger head 108 would, of course, be advanced, and the relation between the inclined wedge surface 114 and the normal inclination of rail 92 is such as to produce a one-half em advance of the plunger as the roller travels between these points. Accordingly, at the end point of any line (the point at which all of the line elements have been displaced), and no matter what may be the line measure for which block 65 and rider 23 are set, the plunger will stand advanced from the block 90 by one-half em.

Due to the normal relatively sharp inclination downwardly to the right of rail 92, roller 107 stands above and clear of the rail upon interruption of the line delivery stroke (simultaneously by lug 67 and rider 23) for all lines whether overset, underset or composed to exact length and for all line measure settings except very short ones, say 4 ems or less which are rarely required. When the rail 92 is operated it swings about its pivot axis 93 into contact with roller 107 and

(a) If the line is underset the rail swings upwardly past the horizontal to some inclination downwardly to the left, Fig. 7, driving the plunger and line leftward until the line is compacted against wall 45, or

(b) If the line is overset the rail swings upwardly toward the horizontal but remains at some inclination downwardly to the right, Fig. 10, driving the plunger leftward only in the event that the line is overset by something less than one-half em, or

(c) If the line happens to be composed to exactly the desired justified length (corresponding exactly to the line measure setting) the rail swings to a true horizontal position and drives the plunger and line leftward exactly one-half em.

The action of the justification space controls will first be discussed under the more usual condition of an underset line, a line as shown in Figs. 6 and 7, in which has been detected a positive quantity of space which must be added in order that when the characters represented by the composed and measured line are photographed they will produce a line of the desired justified length. Upon each advance of the follower unit, as the leading elements are successively displaced into the channel 27, the leftward urge exerted on block 90 by the delivery lever spring 19 together with the reaction of plunger spring 110 and the leftward decline of rail 92 (see Figs. 7, 8 and 9) results in a downward movement of wedge 88 and consequent recession of plunger 89 as roller 107 rides leftward along the top surface of the rail. Fig. 8 shows the plunger receded to an extent commensurate with the advance of the line follower after removal of about one-half of the matrices from the line in Fig. 7.

It will now be evident that for each element displaced out of an underset line the amount of advance leftward of the line follower unit as a whole and of the film (downward under control of racks 22 and 30) will be greater than the actual edgewise body thickness of the displaced matrix (the dimension C in Fig. 2) by the in-

crement resulting from the recession of the plunger 89, that is, from the amount of movement of the plunger in a reverse direction to that in which it was moved by the rail 92 in compacting the composed line of elements. It will also be apparent that the value of such increment will depend upon the inclination of rail 92 for the line in hand and the distance that roller 107 travels along rail 92, and that the latter distance is in turn controlled by and variable directly with the thickness of the particular displaced matrix.

Thus, for the successive photographic exposures in respect to an underset line the film is advanced by the line follower a distance equal to the character width proper (represented by the edgewise thickness of the particular matrix presented on the optical axis O—O) plus a definite and commensurate portion of the total space shortage in the composed line as measured and stored up by the justification space controls. And the value of such plus portion of space will be proportionate in each instance to the width value of the particular character as represented by the matrix thickness. The composed line will, of course, contain blank matrices between words or characters as required, it being well understood that such matrices in thin, medium and thick sizes are comprised in the font of matrices in the storage magazine 1 and are released for assembly by striking space keys as usually provided on the keyboard. Such blank matrices are presented on the optical axis O—O just as are the character matrices but being opaque they simply produce a blank area on the film. But when such matrices are displaced from the line the follower and film advance, of course, and the plunger and wedge act in the manner described above to increment the advance of the film whereby to widen the word space intervals by an amount proportionate to the body thickness of the blank matrices.

The justification action of the control members 88, 89 and 92 in connection with an overset line will next be described in connection particularly with Fig. 10. First, however, it should be pointed out that the machine is arranged to permit the operator to compose a line longer by one-half em than the length desired after justification. The advantage of this facility is that it affords opportunity to fit more characters into a line in effecting the completion of or an acceptable breaking up of a word falling at the end of the line. This in turn enables producing greater uniformity of appearance of the spacing in all lines of the composed matter, it being well recognized that the possibility of adding even a single character to a line will often overcome the otherwise objectionable gaping appearance of spacing so often noticed in the general run of machine set composition.

To enable oversetting a line in the assembling elevator 8, the stop surface 14 for the pointer member 12a of the adjustable assembler slide block 12 may be displaced to allow the slide to advance further than called for by the line measure setting of block 12. As will be clear from Figs. 1 and 1a, the stop surface 14 is constituted by a projection formed on the usual "tight line" release lever 14a which is pivoted in a fixed lug 14b of the rigid assembler frame. Lever 14a hangs by gravity so that surface 14 is normally active as a stop for pointer 12a. If it is desired to admit an additional matrix or two into the composed line the operator may swing lever 14a forwardly (upwardly) so that pointer 12a may advance, and finally stop, directly against lug 14b. In the present instance the projection 14 on lever 14a is made one-half em thick to allow oversetting a line by one-half em, this amount having been found sufficient for most purposes. However, it will be obvious that a greater or less allowance may be provided as may be desired. And, of course, the amount by which a line is overset may be anything within the range of the maximum chosen allowance.

To accommodate overset lines when delivered to the displacement position M^3, the em scale 66 on crossbar 60 and the similar scale 24 on the film feed rack 22 are both fastened in a position offset to the right by one-half em. While this purposeful arrangement still enables the operator to read the settings of block 65 and rider 23 directly relative to the markings on their respective scales it provides at all times an extra one-half em of space between wall 45 and the matrix engaging face of the plunger head 108 when the latter is fully retracted, as it always is upon delivery of lines to the position M^3.

Referring now to Fig. 10, the line delivery stroke has been stopped by engagement of the follower block 90 against lug 67 and crossbar 60 has been elevated to engage lug 67 in notch 76 of block 90, the cam shaft having turned far enough to accomplish the latter engagement and to operate the rail 92. Since the delivered line is assumed to be overset by one-half em it already occupies all of the space between wall 45 and the plunger head 108—a space which is one-half em longer than provided for the actual line measure settings of block 65 and rider 23 relative to the offset scales 66 and 24 respectively. Accordingly, the plunger and wedge are incapable of movement by rail 92 when the latter is acted upon through the dropping of roller 100 off the high surface of cam 94. Thus, rail 92 simply swings on pivot 93 from its normal and relatively sharp inclination (downwardly to the right) as indicated in Fig. 6 to a lesser inclination in the same direction until it is stopped by roller 107, it being remembered that even for the maximum overset line the normal inclination of rail 92 is such that roller 107 stands clear of the rail until the latter is operated. And it will also be remembered that the follower block cannot move backwardly (to the right) under the upward urge of rail 92 because it is locked by lug 67. Therefore, rail 92 becomes locked by bolt 121 at the inclination it assumes upon contact with roller 107. Bar 60 is then lowered to release the line follower from lug 67 ready for the element displacing and step-by-step line and film advancing actions. The space sensed or detected and stored up for subsequent division and distribution is in this instance a negative quantity—a quantity to be deducted from the length of the line as composed in order to produce a line of the desired justified length.

During the ensuing displacement successively of the matrices the follower unit and remaining matrices advance leftward as before but in this instance the wedge 88 is forced to slide upwardly and to advance plunger 89, 108 toward wall 45 simultaneously with the travel of roller 107 along the upwardly inclined rail 92. Thus, upon each displacement of a matrix the leftward advance of the follower block 90 and film feed racks 22, 30 will be less than the actual edgewise thickness of the displaced matrix by the amount of advance each time of the plunger relative to the

follower. And it will be apparent that the value of the decrement thus imposed upon the advance of the follower depends each time upon the distance that roller 107 travels along the upwardly inclined rail 92 and that this distance is controlled by and varies directly with the body thickness of the particular displaced matrix.

Thus, for each photographic exposure in respect to an overset line the film is advanced a distance less than the width of the character, as represented by the matrix thickness, by a definite portion of the total excess or overage in the length of the composed line as measured and stored up negatively by the justification control members. The photographed characters therefore stand closer together and the word spaces resulting from the blank matrices are also reduced, the total excess of detected space, say one-half em, being distributed among all of the characters and word spaces throughout the line in proportion to their widths as represented by the variant thicknesses of the respective line elements.

It will be understood that in no case is it possible for the photographed characters to appear overlapped due to this decremental justification action since an allowance for oversetting to such extent as might produce this effect would, of course, be wholly impractical. Moreover, it is a well known fact that while the thickness of the matrices is proportionate to the character width, such thickness provides an allowance in excess of the actual width dimension of the character proper in order always to give a normal space separation between characters. This is commonly known (in connection with matrices employed for casting type bearing slugs) as the "side wall clearance" and the photographable matrices herein employed embody this same accepted principle of construction.

Should it happen that the length of a line as composed be exactly equal to the desired justified length (a rare occurrence but nevertheless possible) then roller 107 would stand clear of rail 92 as it always does upon interruption of the line delivery stroke by lug 67. Upon starting of the cam shaft rail 92 would swing against roller 107 and move the wedge upwardly to such extent as to advance the plunger and matrix line leftward one-half em, thus to account for the one-half em excess space allowance (for oversetting) as provided between wall 45 and the follower 90 when the plunger is fully retracted. The leading end of the line would now be pressed against wall 45 and prevent further upswing of rail 92. And in this instance (a line composed to exact justified length) rail 92 would assume a true horizontal position and be locked in such position by bolt 121. It will now be apparent that during the successive advances of the follower unit after each displacement of an element there will be no relative movement between the plunger 89 and the wedge 88 as the roller travels along the horizontal rail 92. Accordingly, the successive advances of the film by the follower unit will be determined and controlled solely by the variant thicknesses of the displaced matrices. In other words, the operated position of the justification controls in this case indicate a neutral condition wherein the photographed characters will appear in exact justified relation in a direct manner, that is, without incrementing or decrementing their width values.

After removal of the last matrix from either an overset or an underset line or from a line composed to exact length, the line follower unit will have advanced to the position shown in Fig. 9. Here the axis of roller 107 coincides exactly with the axis of the pivot pin 93 for rail 92 and the matrix engaging face of the plunger head 108 lies against the wall 45 of the feed channel 27 with the plunger extended one-half em from block 90. This represents the end point of the photographed line, that is, the point of completion of the second function of the control members, that of dividing up and distributing the total space necessary to be absorbed in increasing or decreasing the length of the composed line in order to justify it.

To repeat, the plunger 89, 108 is always extended one-half em at the "line-end" point in order to compensate for the extra one-half em space allowance provided between wall 45 and block 90 for oversetting purposes, the normal relation between rail 92, rail 107 and the axes of said rail and roller in order to assure this one-half em extension of plunger at the end point of a line having already been explained. And from the foregoing description it will be evident that the rate of relative movement of wedge 88 and the plunger 89, 108 (during the element displacing and photographing actions) from their operated positions to the one-half em "line-end" extended position of the plunger head depends entirely upon the locked inclination of rail 92 for the particular line being operated upon.

It will be understood that for each new line the film, or the holder 20 for it, has a common initial starting position which is determined by the engagement between stops 80 and 81. Therefore, as the film holder advances step-by-step downwardly the recumbent characters on the matrices are successively photographed in line and in space-adjusted or justified relation from this common starting point as a left hand margin to a common end point or right hand margin which latter may differ, of course, for the different line measures required for various pieces of printed matter. After completion of each line the film holder is returned to its starting position as will shortly be explained and the film may be advanced in any suitable manner for line spacing, for example, as by moving it or the film holder laterally to bring a fresh area into alignment with the optical axis.

Restoration of parts

When the line follower unit reaches the "line-end" position shown in Fig. 9, the tapered left end of latch 51 encounters a screw 125 fixed in the front edge of plate 45. As indicated, this screw holds latch 51 rocked so that its hooked right end clears arm 50 of the follower, thus releasing the latter for subsequent restoration by its cam 53 to the normal position shown in Fig. 1.

The return stroke of the line follower does not take place, however, until somewhat after the last removed matrix which allowed the follower to reach the end position in Fig. 9 has been discharged from the top of the feed channel 27 onto the elevator bar 43 and until rail 92 has been restored to its normal position as will shortly appear. As pointed out earlier in this specification the timing mechanism provided delays the starting of the second part of the cam shaft cycle, to effect restoration of the various parts, until the reciprocating feed bar 26 has made the necessary strokes to feed the last removed matrix to the discharge position. The timing mechanism referred to then operates to energize the start-

ing relay 214 in order to throw in the main driving clutch. The cam shaft now turns from the position shown in Fig. 12 and completes a full cycle of operation upon arrival of pawl 54 on its seat on pawl 204 whereupon the clutch is disengaged.

As the cam shaft 47 starts turning from the stopped position indicated in Fig. 12, the first action occurring is that of rocking lever 117 to release the locking bolt 121, it being observed that at the stopped position of the shaft, roller 122 of lever 117 rests at the end of the low portion of its operating cam 116 ready to be acted upon the moment the cam starts turning. Immediately following such release of bolt 121 the rise on cam 94 which rise lies close to roller 100 in the stop position of Fig. 12 acts on this roller and rocks lever 95 clockwise. Rod 96 connected to this lever is then pulled down and restores rail 92 to its normal position (inclined downwardly to the right) as shown in Figs. 1 and 6. Roller 107, however, remains in contact with rail 92 with its axis aligned with the pivot axis 93 of the rail. At this moment the usual outwardly flaring side surface (not shown) of cam 53 (the far side as viewed in Fig. 11), engages in a manner well known in machines of the Mergenthaler class with the roller 15a on the arm at the inner end of the delivery lever shaft 16, see Fig. 11. Shaft 16 and the delivery lever 15 fast thereto are then rocked clockwise (as viewed in Fig. 1) whereby to return slide 18 and the line follower unit thereon to the right until latched by the gravity latch 8a. Shortly after the follower unit starts its return movement roller 107 leaves contact with rail 92 and wedge 88 and plunger 89 are then free to assume their normal positions relative to the follower block 90, spring 110 acting to retract the plunger and to aid the dropping downward of the wedge until stopped by screw 105.

Crossbar 60 is elevated to the normal or line receiving level when, toward the completion of cam shaft cycle, roller 73 rides from the concentric high surface 77 of its cam 64 onto the lower intermediate surface 78 of said cam, the roller resting on this intermediate surface, at about the end thereof as shown in Fig. 11, when the cam shaft is finally stopped by pawl 54. It will be understood that during this second part of the cam shaft cycle (about 210 degrees) the second elevator cam (not shown) operates as usual to raise the elevator 5 together with the discharged line of matrices accumulated on the ribbed bar 43 thereof to the usual distributing devices (not shown) of the machine, the elevator then remaining at the distributing station until the start of the next cycle of operation.

We claim:

1. In apparatus for producing a justified line of type matter, in combination, a composed line of character-representing elements, representing the characters to be produced to make such line of type matter and representing dimensionally the variant setwise widths of such characters, means operative to determine the effective difference between the length of said composed line and the length of the line to be produced including a movable member, means cooperative with said composed line of elements and operative to position said movable member to a position determined by said line-length difference, means responsive to the successive elements for successively producing the represented characters, distributing means arranged for cooperation with said responsive means to distribute among the produced characters the total amount of said line-length difference in proportion to the setwise widths of said characters, said distributing means including setwise space dimension-changing means and movable follower means operative under control of said movable member and said responsive means to change said dimension changing means as said follower means moves with respect to said movable member, the extent of said change due to said movement being proportioned to the setwise width of the character being produced.

2. In apparatus for producing a justified line of type matter, in combination, a composed line of elements representing variant width characters to be produced to make said line of type matter; means operative to determine the effective difference between the length of said composed line of elements and the length of the line to be produced including a movable member; means cooperative with said composed line of elements and operative to set said movable member at a position corresponding to said line-length difference; means responsive successively to the individual elements of the composed line for producing the characters represented thereby, said responsive means including movable character producing means movable to successive positions corresponding to the setwise widths of the successively produced characters; distributing means cooperating with said responsive means and operative to distribute among the produced characters the total amount of said line-length difference in proportion to the setwise widths of said distributing characters, said means including wedge means movable in the same direction as said movable character-producing means and movable by said movable member in a direction normal to said first direction, and wedge follower means movable by said wedge means to vary the movement of said movable character-producing means to vary the setwise spacing of the produced characters in accordance with their setwise widths, the extent of movement of said wedge follower means being proportioned to the extent of movement of said wedge means in said normal direction.

3. In apparatus for producing line of type matter from a composed line of elements representing symbolically and dimensionally the characters and word spaces to be produced to make such line of type matter, in combination, measuring means movable into cooperative relation with one end of the composed line of elements to compact them against a fixed wall at the opposite end, said measuring means being operative according to the extent of its movement to determine the difference between the composed and justified line-lengths, producing means operative in accordance with the dimensions of the successive elements of said composed line of elements for progressively producing the characters and word spaces represented thereby in spaced relation, and distributing means movable in response to the operation of said producing means and controlled by said measuring means for distributing among the word spaces and the spaces between the characters throughout the line of type matter produced the total amount of said line-length difference in amounts proportioned to the space occupied by each character and word space produced.

4. Apparatus for producing a justified line of type matter from a composed line of character

representing elements having body dimensions corresponding to the widths of the respective characters represented thereby, comprising a line follower, a compacting member movable relative thereto in the direction of the body dimensions of said elements while the follower is held in a fixed position and operative to compact the elements and thereby measure the variance between the composed and justified line-lengths, dimension changing means for operating said compacting member, an actuating member for actuating said dimension changing means and tiltable into an inclined position determined by the extent of movement of said compacting member, and operating means operative to advance said follower and compacting member relative to said tilted actuating member, producing means cooperating with the operation of said operating means to progressively produce the characters represented by the elements of the composed line, the extent of the advances of the line follower being governed by the said body dimensions of the respective elements and by the changes introduced by said dimension changing means under control of said tilted actuating member.

5. Apparatus for producing lines of type characters from composed lines of individual elements of various thicknesses and bearing type characters of correspondingly varying widths, comprising compacting means operative to compact the composed line of elements from one end and gauge the variation between the length of the compacted line and a line of a desired length, means for progressively reproducing in a line the characters on said elements including an operating member operatively related to said compacting means and movable in successive steps proportioned to the thicknesses of the successive elements in the composed line, a movement modifying element associated with said line compacting means and said operating member for altering the relation between the compacting means and said operating member to modify the movement of said member as the latter moves by amounts proportioned to the ratio of the gauged line-length variation to the respective thicknesses of the successive elements.

6. Apparatus for producing a justified line of type characters from a composed line of elements of various thicknesses and bearing type characters of correspondingly varying widths, comprising means for displacing the elements successively from the composed line, means for reproducing the characters of the displaced elements individually including an impression receiving medium, advancing means for advancing the elements remaining in the composed line after each displacement of an element and a medium-moving means controlled by said advancing means to advance said medium after each such displacement an extent basically determined by the thickness of said displaced element, a line compacting member and a space apportioning member said member being relatively movable and coacting to compact the composed line of elements from one end prior to the displacing operation and measure the variance between the length of such line and the desired justified line-length, means for locking said space-apportioning member in a space-apportioning position, and means controlled by said space-apportioning member for varying the relation between the medium-moving means and said advancing means to alter the extent of each advance of the medium by an amount which is a function of the line-length variance and of the thickness of the displaced element.

7. Apparatus for producing a justified line of type characters of a desired length from a composed line of elements of various thicknesses and bearing type characters of correspondingly varying widths, comprising a follower operative to compact the composed line and determine the amount of variation between its length and the desired length of a justified line, means for displacing the elements successively from the composed line, means for reproducing the characters of the displaced elements, a member operable to an extent determined by the extent of operation of said follower in compacting the composed line, spacing means for spacing the reproduced characters including a spacing member operatively related to said follower and adapted to advance progressively in steps as the elements are displaced from the composed line said step advances being proportioned to the thicknesses of the displaced elements, and a space-modifying member interposed between the follower and the spacing member and operative to modify the total advance thereof by an increment or decrement determined by the extent of operation of the follower in compacting the composed line and to modify the step advances by amounts proportioned to the thicknesses of the successively displaced elements.

8. Apparatus for producing a justified line of type characters from a composed line of elements of various thicknesses and bearing type characters of correspondingly varying widths, comprising a follower operative to compact the composed line and determine the amount of variance between its length and the desired length of the justified line, an actuating member operable to an extent determined by the extent of operation of said follower in compacting the composed line, locking means for locking said member in its actuated position, element-displacing means for displacing the elements successively from one end of the compacted line of elements and means for reproducing the characters of the displaced elements, line-element-advancing means for advancing the remaining elements and also the follower after each displacement of an element to bring the next element into position for displacement, and space-adjusting means operative under control of the locked actuating member to produce differential movements of said follower relative to the line element advancing means in amounts proportioned to the thickness of each displaced element.

9. Apparatus for producing a line of type characters justified to a desired length from a composed line of character bearing elements having dimensions in a direction endwise of the line which represent the variant widths of their respective characters, comprising character space controlling members relatively movable with respect to normal positions corresponding to the justified line-length to respective cooperating positions determined by the length of the composed line of elements and defining by their respective cooperative positions upon completion of such movement the ratio between the composed and justified line-lengths, producing means for progressively reproducing in line the characters of said elements including character-space-producing mechanism adapted normally to progressively advance the composed line of elements endwise in amounts determined by the said dimensions of the respective elements being re-

produced and operative to produce the spacing of said reproduced characters, and an adjusting member adapted for movement relative to said space controlling members as the line is advanced and operative to alter the normal line advances by said character-space-producing mechanism and the consequent spacing of said reproduced characters in correspondence with the line-length ratio defined by said space controlling members.

10. Apparatus for producing a line of type characters justified to a desired length from a composed line of character bearing elements varying in thickness according to the variant widths of their respective characters, comprising a line compacting member movable in the direction of thickness of the elements from a set position defining the justified line length into a line-compacting position and providing by the extent of its movement to compact the line a measure of the difference between the composed and justified line-lengths, an operating and control member operative to actuate said line-compacting member into its line-compacting position, said operating and control member being swingable from an inactive position to an inclined position determined by the extent of movement thereby of said line-compacting member and defining by its inclination relative to the path of movement of the line-compacting member the ratio of said composed line-length to the justified line length, and locking means operative to hold said member in its actuated position, means operative to advance the compacted line of elements endwise variable steps in accordance with the various thicknesses of the elements to effect reproduction progressively of the characters thereon, said means including a line follower operative to move the line compacting member and being movable relative thereto, and a movable character space controlling member interposed between said compacting and operating and controlling members and adapted to follow the inclination of the operating and controlling member as the follower advances and to effect, upon each advance of the follower, an extent of relative movement between said follower and line-compacting members determined by the ratio defined by the inclination of the operating and controlling member.

11. Apparatus for producing a justified line of type characters from a composed line of elements of various thicknesses and bearing type characters of correspondingly varying widths, comprising a line follower having a compacting member therein slidable endwise from a set position defining the justified line length to compact the elements in the direction of their thicknesses and thereby measure the variance between the composed and justified line-lengths, a wedge slidable vertically in the follower for operating said compacting member, a pivoted member for actuating said wedge, locking means for locking said pivoted member in an inclined position determined by the extent of movement of the compacting member by said wedge in compacting the composed line of elements, reproducing means for progressively reproducing the characters of the line elements, and operating means operative normally to advance the follower progressively for each such reproduction and extent determined by the thickness of the element whose character is being reproduced, the extent of such advances being modified by appropriate portions of said measured line-length variance as determined by a relative movement between the wedge and compacting member as said wedge follows the inclination of said pivoted member during the advance of the follower.

12. Apparatus for producing a justified line of type characters of a desired length from a composed line of elements of various thicknesses and bearing type characters of correspondingly varying widths, comprising a channel for supporting the composed line of elements between a fixed end wall and a movable line follower set and held initially a distance therefrom related to the justified line-length, reproducing means having a reproducing position for progressively reproducing in a line the characters of the line of elements including element transferring means for displacing the elements singly from the end of the line adjacent to the fixed end wall and moving them individually in succession to the reproducing position, cooperative line compacting members carried by said follower and movable relative thereto to compact the line of elements against said fixed end wall prior to the element-displacing operation, a pivoted operating and control member movable to positions of inclination with respect to said channel and thereby operative to actuate said compacting members to the extent required to compact the line of elements, the extent of movement of the compacting members defining the amount of variance between the composed and justified line-lengths and the position of inclination of the operating and control member defining the ratio of said variance to the justified line-length, means for locking said operating and control member at its inclined position, means for releasing the line follower from its set position, and means for advancing the follower and said compacting members after each element displacing operation to advance the remaining line elements in compacted relation for the succeeding displacing and character reproducing operations, the extent of each advance of the follower being determined by the thickness of the then displaced element and an increment or decrement provided by relative movement between the line compacting members and the follower as the latter moves said line-compacting members relative to the inclined operating and control member.

13. Apparatus for photographically producing a line of type characters from a composed line of character-bearing elements varying in thickness according to the width of the characters thereon, comprising a sensitized surface, displacing means for displacing the elements individually from one end of the composed line to present the characters thereof successively at a photographing position relative to said surface, a line follower for advancing the remaining line of elements to bring each next element to the displacing means, positive connections between said line follower and sensitized surface for advancing them concurrently for each element displacement to space the successive photographic impressions, and intermediate mechanism operative under control of the various thicknesses of the successively displaced elements to produce an additional movement of the connected follower and sensitized surface relative to the remaining advanced line of elements proportionate for each such advance to the thickness of the then displaced element.

14. Apparatus for photographically producing a line of type characters from a composed line of character-bearing elements varying in thickness according to the width of the characters

thereon, comprising a channel to contain the composed line of elements, displacing means for displacing the elements singly from one end of the composed line, a line follower for advancing the remaining line of elements along said channel to fill the space left therein by the displaced element, a sensitized surface positively connected to said follower for movement therewith for receiving photographic impressions of the characters on the successively displaced elements and movable by said line follower as said line follower advances the line of elements, and intermediate mechanism for controlling the spacing of the photographed characters and operative to vary the extent of the advances of the connected line follower and sensitized surface relative to the extent of the corresponding advances of the remaining line of elements whereby to variably space the characters in accordance with their variant widths.

15. Apparatus for photographically producing a line of type characters from a composed line of character-bearing elements varying in thickness according to the width of the characters thereon, comprising a movable sensitized surface, displacing means for displacing the elements singly from one end of the composed line and for moving them in succession to a photographing position, a line follower positively connected to said sensitized surface for concurrent movement therewith and operative to advance the remaining line elements to fill the space left by a displaced element, and character space controlling mechanism comprising a slidable member carried by the line follower and movable relative thereto to compact the elements before the displacing operation, operating means for initially actuating said slidable member to compact the elements, and subsequently to induce movement of said slidable member relative to said operating means as said slidable member maintains the elements in compacted condition during the displacing operation, the extent of advance of the connected line follower and sensitized surface after each displacement of an element being determined by the thickness of the then displaced element and by the amount of relative movement between said slidable member and its operating means.

16. Apparatus for photographically producing a line of type characters from a composed line of character-bearing elements varying in thickness according to the width of the characters thereon, comprising a movable sensitized surface for receiving photographic impressions of the characters on the elements, displacing means for displacing the elements singly from one end of the line and for moving them in succession to a photographing position, a line follower positively connected to said sensitized surface for concurrent movement therewith and operative to advance the remaining line elements and the sensitized surface in accordance with the various thicknesses of the successively displaced elements, and character space controlling mechanism cooperative with the line of elements and operative as the line follower advances to alter its extent of advance over that of the advance of the remaining line of elements and to correspondingly alter the spaced relation of the photographic impressions on the concurrently moved sensitized surface.

17. Apparatus for producing lines of type characters from composed lines of individual elements of various thicknesses and bearing type characters of correspondingly varying widths, comprising compacting means operative to compact a composed line of such elements and determine the variance between the length of such line containing the characters variably spaced directly in accordance with the thicknesses of the respective elements and a line containing such characters spaced differently but in proportion to their variant widths, reproducing means for progressively reproducing in a line the characters on said elements including a line-advancing member movable to advance the composed line of elements progressively varying amounts determined by the various thicknesses of the elements, and space-adjusting means carried by said line advancing member and movable relative thereto under control of the compacting means as said line-advancing member advances the line, said space-adjusting means being operative to adjust the extent of the movements of the line advancing member over that of the advances thereby of the line of elements whereby to adjust the spaced relation of the reproduced characters.

18. Apparatus for photographically producing a line of type characters from a composed line of character-bearing elements varying in thickness according to the width of the characters thereon, comprising a movable sensitized surface for receiving photographic impressions of the characters on the line elements, displacing means for displacing the elements singly from one end of the line and for moving them in succession to a photographing position, element-advancing means for advancing the remaining line of elements in compacted relation to fill the space left by the thickness of the displaced elements, responsive means responsive to said element advancing means and relatively movable with respect thereto and operative to advance the sensitized surface relative to said photographing position as the elements are successively displaced, and character space controlling means operative to relatively move said responsive means and element advancing means amounts determined by the thicknesses of the successively displaced elements.

19. Apparatus for photographically producing a line of type characters justified to a desired length from a line of character-bearing elements composed to a different length and varying in thickness according to the width of the characters on said elements, comprising means for progressively photographing the characters on the elements including a movable sensitized surface and means for displacing the elements singly from the line and moving them in succession to a photographing position operatively related to said surface, and character space controlling mechanism including relatively movable members cooperative with the line of elements as the elements are successively displaced and constructed and arranged to move the sensitized surface successive extents differing from the thicknesses of the respectively displaced elements by an amount for the entire line equal to the difference between the composed and justified line lengths.

20. Apparatus for photographically producing a line of type characters justified to a desired length from a line of character-bearing elements composed to a different length and varying in thickness according to the width of the characters on said elements, comprising means for progressively photographing the characters on the elements including a movable sensitized surface and

displacing means for displacing the elements singly from the line and moving them in succession to a photographing position operatively related to said surface, and character space controlling mechanism cooperative with the line of elements and operative to control the movement of the sensitized surface for the successive photographic exposures, said character-space-controlling mechanism including cooperating members and operating means for moving them from starting positions prior to the operation of said displacing means to an extent determined by the difference between the composed and justified line lengths and for moving them reversely one relative to the other toward said starting position as the elements are successively displaced, said members being so constructed and arranged as to move the sensitized surface in a ratio to the various thicknesses of the displaced elements determined by the extent of relative movement between said members back to their starting position.

21. In apparatus for producing a justified line of type matter from a composed line of elements representing symbolically and dimensionally the variant width characters and word spaces to be contained in the justified line, in combination; opposed end walls between which to confine the composed line of elements endwise, said walls being spaced apart a distance corresponding to the justified line-length; a compacting member movable from one of said walls against the line of elements to compact them against the other wall and operative to gauge the difference between the length of the composed line and the justified line-length; an actuating member for actuating said compacting member to the required extent and means operative to lock said actuating member in actuated position; means adapted to cause the compacted line of elements and said compacting member to advance progressively relatively to said locked actuating member and in accordance with the variant character and space widths represented, and an interponent member movable relative to said compacting and actuating members under the influence of said advancing action of said line of elements and operative to distribute the gauged amount of line-length difference among the characters and spaces produced in proportion to the variant widths thereof as represented by the respective elements of the composed line.

22. In apparatus for producing a line of type matter justified to a desired length from a composed line of elements representing the characters to be contained in such line and their respective variant setwise widths, in combination, compacting means movable from a position corresponding to the desired line-length and operative to compact such line of elements to gauge the total difference between its length and said desired line-length, means for progressively producing in a line the characters represented by said elements including devices operative to cause said compacting means and the line of elements to advance progressively in accordance with the setwise character widths represented by the successive elements, and means cooperative with said compacting means during the line advancing action to alter the effective extent of each advance of the line of elements by a portion of said gauged line-length difference proportionate to the character width represented by the corresponding element.

23. In apparatus for producing a line of type matter justified to a desired length from a composed line of elements representing the characters to be contained in such line and their respective variant setwise widths, in combination, gauging means operative to gauge the difference between the desired justified line-length and the length of such composed line of elements as determined by the aggregate of the setwise character widths represented by the elements, producing means for progressively producing in a line the characters represented by the composed line of elements including a line advancing member for advancing the composed line of elements and responsive to the setwise character width representations of the successive elements as the line thereof is progressively advanced, and means adapted for movement relative to said line advancing member under control of said gauging means and operative to distribute portions of the gauged amount of line-length difference among the characters produced in proportion to their respective setwise widths.

24. In apparatus for producing a line of type matter justified to a predetermined length from a composed line of elements representing the characters to be contained in such line and defining by their body thicknesses in the direction of the length of the composed line the variant widths of the respective characters, in combination, a line compacting member movable forwardly with respect to a null position corresponding to the predetermined line-length to an extent determined by the length of the composed line of elements, actuating means for said line-compacting member including a lock for retaining said actuating means in an operated position corresponding to the extent of movement thereby of the line-compacting member, producing means for progressively producing in a line the characters represented by the entire composed line of elements including a follower adapted to advance said line-compacting member and the compacted line of elements step-by-step relative to said locked actuating means and in response to the body thicknesses of the successive elements, and said follower itself being advanced similarly by said line advances and means cooperative with said follower and actuating means and operative to alter the step-by-step advances of the follower in accordance with the movement of the compacting member by the locked actuating means as said compacting member is advanced relative to said locked actuating means.

25. Apparatus for producing a line of type matter justified to a desired length from a composed line of character representing elements each having a thickness dimension representing the setwise width of the type character it represents, comprising mechanism operative to an extent to compact the composed line of elements from one end in the direction of their thicknesses and providing by the extent of its operation a measurement of the total variance between the composed and justified line-lengths, movable producing means responsive to the thickness dimensions of the successive elements of said composed line of elements for progressively producing in a line the characters represented thereby, and space-allocating means operative under the influence simultaneously of said mechanism and movable producing means to distribute among the spaces between the characters in the line of type matter produced the total amount of the measured line-length variance in varying

amounts for each character proportionate to its setwise width.

26. Apparatus for producing a line of type matter justified to a desired length from a composed line of elements of various thicknesses and bearing type characters of correspondingly varying widths, comprising compacting mechanism operative to an extent to compact the composed line of elements from one end in the direction of their thicknesses and providing by the extent of its operation a measurement of the variance between the composed and justified line-lengths, movable reproducing means operative normally to respond to the thickness of the successive elements to reproduce the characters thereof in correspondingly spaced relation, and said compacting mechanism including space-adjusting means cooperative with said movable reproducing means and operative to alter the spaced relation of the reproduced characters by increments or decrements proportionate to their respective widths according to whether the length of the compacted line of elements as measured by the extent of operation of said mechanism is less or greater than the desired justified line-length.

27. In apparatus for producing a justified line of type matter, in combination, a composed line of individually separable means representing characters of variant widths to be produced to make said line of type matter, means operative to determine the effective difference between the length of said composed line and the length of the line to be produced including a positionable cam, movable means cooperative with said separable means and operative to set said cam to a position corresponding to the said determined line-length difference, means for successively removing from the line the individual separable means and producing means responsive to each removing operation for producing the respective characters represented, a cam follower, and means including said cam and cam follower for cooperating with said producing means to distribute among, the spaces between the produced characters the total amount of said line-length difference.

28. In apparatus for producing a justified line of type matter, in combination, a composed line of individually separable character representing means and representing the variant width characters to be produced to make said line of type matter, movable character-producing means responsive successively to the individual character-representing means of said composed line for producing the characters represented thereby, operating means operative to determine the effective difference between the length of said composed line and the length of the line to be produced including a movable member movable relatively to the character producing means, means cooperative with said composed line of characters representing means and operating means for moving said movable member in one direction relatively to said character-producing means to a position corresponding to the said line-length difference, and means including a movable line follower having a cooperative relation with said movable member and said character-producing means and operative to move said movable member, and character-producing means relatively to the operating means to cause movement of said movable member in a reverse direction relatively to the character producing means as the latter is moved for each character producing operation, the extent of each reverse movement of said movable member being governed by and varying in accordance with the width of the then produced character, and the instant alteration of the cooperative relation between the line follower and producing means due to such reverse movement determining the effective extent of movement of the character-producing means necessary to distribute among the space between the characters produced the total amount of line-length difference in portions proportionate to the variant widths of the respective characters.

29. In apparatus for producing a justified line of type matter of desired length, in combination, character representing elements having dimensions varying in accordance with the setwise widths of the represented characters, composing means for composing said elements into a line, character producing means for successively producing in a line on a surface the characters represented by the successive elements of said composed line, a positionable member positionable in accordance with the difference between the length of said justified line and the length of the unjustified line that said composed line of elements would produce, a movable member responsive to and successively movable in proportion to the said dimensions of the successive elements, mechanism for relatively moving said surface and character producing means to align a fresh portion of said surface for each character produced, and responsive means responsive algebraically to said positionable member and to said movable member to cause said mechanism to relatively move said surface and character producing means in proportion to said dimension of each element and the setting of said positionable member.

30. In apparatus for producing a justified line of type matter of desired length, in combination, a composed line of character representing means including means representing the setwise width of each individual character represented, character producing means responsive to said composed line of character representing means for successively producing each character represented, a positionable member positionable in accordance with the difference between the desired justified line-length and the length of the unjustified line that said composed line of character representing means would yield, a movable member responsive to said composed line of character representing means and in accordance therewith successively movable in amounts proportionate to the represented setwise widths of the successive characters represented, and responsive means responsive algebraically to said positionable member and to said movable member to cause said character producing means to allot space to each character produced in an amount proportionate to its setwise width and to the setting of said positionable member.

31. Apparatus for producing lines of type characters from composed lines of individual elements of various thicknesses and bearing type characters of correspondingly varying widths, comprising cooperative compacting members and means for moving them one relative to the other to an extent for compacting a composed line of such elements to thereby provide a measurement of the variance of the length of said line from a predetermined line measure, character-reproducing means for successively reproducing in a line the characters on said elements and including a progressively movable member cooperative with the compacting members in their moved

positions and movable progressively to extents determined by the various thicknesses of said elements, and an interponent moved by said progressively movable member under control of said compacting members during the operation of the character reproducing means and causing said progressively movable member to move to extents differing from the thicknesses of the respective elements in accordance with the ratio of said thicknesses to the measured line-length variance.

32. Apparatus for producing a justified line of type characters from a composed line of elements of various thicknesses and bearing type characters of correspondingly varying widths, comprising means for progressively reproducing in a line the characters on said elements and including an impression receiving medium, responsive devices connected to said medium and responsive successively to the thicknesses of the elements to move the medium progressively for receiving the successive character reproductions in justified spaced relation, cooperative line measuring members for compacting the composed line of elements and means for moving said members one relative to the other to an extent determined by the amount of variance in the length of the compacted line of elements from the desired length of the justified line, means for locking one of said line measuring members in its operated position, and means movable under control of said locked line-measuring member as said responsive devices respond to the thicknesses of the successive elements, for varying the extent of movement of said medium by said devices over an extent corresponding to the actual thicknesses of the respective elements, the amount of such variation at each response being dependent upon the ratio of the thickness of the particular element to the line-length variance as determined by the position of the locked line measuring member.

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